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AMERICAN COLLEGE OF DENTISTS

Convocations have been held on this schedule (since organization in *Boston*, Aug. 20 and 22, '20): (1) *Chicago*, Jan. 26, '21; (2) *Milwaukee*, Aug. 13 and 18, '21; (3) *Montreal*, Jan. 25, '22; (4) *Los Angeles*, July 16 and 19, '22; (5) *Omaha*, Jan. 23, '23; (6) *Cleveland*, Sep. 12, '23; (7) *Chicago*, Mar. 5, '24; (8) *Dallas*, Nov. 12, '24; (9) *Louisville*, Sep. 22, '25; (10) *Philadelphia*, Aug. 22, '26; (11) *Chicago*, Jan. 26, '27; (12) *Detroit*, Oct. 23, '27; (13) *Minneapolis*, Aug. 19, '28; (14) *Chicago*, Mar. 24, '29; (15) *Washington, D. C.*, Oct. 6, '29; (16) *Denver*, July 20, '30; (17) *Memphis*, Oct. 18, '31; (18) *Buffalo*, Sep. 11, '32; (19) *Chicago*, Aug. 6, '33; (20) *St. Paul*, Aug. 5, '34; (21) *New Orleans*, Nov. 3, '35; (22) *San Francisco*, July 12, '36; (23) *Atlantic City*, July 11, '37; (24) *St. Louis*, Oct. 23, '38; (25) *Milwaukee*, July 16, '39; (26) *Baltimore*, March 17, '40; (27) *Cleveland*, Sep. 8, '40; (28) *Houston*, Oct. 26, '41. [Next Convocation, *Boston, Mass.*, Sunday, Aug. 23, 1942.]

Sections and dates of meetings in College year of 1941-42 (between convocations):—(1) *Kentucky*: June 4, '42. (2) *Northern California*: Feb. 4, '42. (3) *Maryland*: May 18, '42. (4) *New York City*: Nov. 14, '41; Feb. 16, May 18, '42. (5) *Minnesota*: Mar. 5, May 4, '42. (6) *New England*: Nov. 26, '41. (7) *Wisconsin*: Mar. 22, '42. (8) *Colorado*: Jan. 26, June 19, '42. (9) *Pittsburgh*: Dec. 3, '41; Jan. 28, Feb. 18, Mar. 12, May 2, '42. (10) *Iowa*: May 5, '42. (11) *Illinois*: Dec. 8, '41; Feb. 9, 22, May 25, '42. (12) *St. Louis*: June 15, '42. (13) *Oregon*: Dec. 12, '41; Mar. 14, June 13, '42. (14) *Texas*: Apr. 26, '42. (15) *Florida*: Dec. 9, '41. (16) *Indiana*: Jan. 12, '42. (17) *Southwestern*: (18) *Washington (D. C.)*: Jan. 29, Mar. 10, '42. (19) *New Jersey*: Nov. 25, '41; Feb. 10, Apr. 28, '42. [Revised as of June 19, 1942.]

Objects: The American College of Dentists "was established to promote the ideals of the dental profession; to advance the standards and efficiency of dentistry; to stimulate graduate study and effort by dentists; to confer Fellowship in recognition of meritorious achievement, especially in dental science, art, education and literature; and to improve public understanding and appreciation of oral health-service."—*Constitution, Article I.*

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Forfeiture of membership: "Membership in the College shall be automatically forfeited by members who (a) give courses of instruction in dentistry, for *remuneration*, under any condition other than those of an appointed teacher serving publicly under the auspices of a dental school, dental society, hospital, or other accredited professional or educational agency; or (b) give courses of instruction in dentistry in a privately owned undergraduate or postgraduate dental school; or in a school that is associated with an independent hospital or dispensary but is not an organic part of it; or (c) exact exorbitant fees for courses of instruction in dentistry under any auspices." . . . —*Constitution, Article II.*

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PROFESSIONAL MEN

WILMER SOUDER, Ph.D.

Washington, D. C.

Every dentist will insist that his status is that of a professional man. It is not easy to write the specifications for a professional man. The definition of "profess" includes the following: to declare, to know, to decide, to show how and to perform. A negative definition of "professional" is: not amateur. The amateur acts for his own satisfaction, which indicates that the professional man should expect to put forth efforts beyond those necessary for his own personal pleasure.

The educational department and the examining board of a state vouch for a minimum quality and quantity of knowledge, and require proof of a minimum ability to perform, as of a certain date. Thus equipped and sponsored, it is incumbent upon the dentist to assume responsibilities for those members of society who need advice and service.

Opportunities for excursions from the professional path come early. A decision has to be made. Shall the restoration be of amalgam, economical at \$5.00; of tediously condensed foil, excellent at \$10.00; or of the cast-gold inlay-type, impressive at \$20.00 to \$100.00. The patient may be susceptible to "professionalized" sales talk. Will the dentist abandon his professional status and, with his patient, drop to the level of salesmanship? He may find many excuses for doing so.

Again he encounters temptations in selecting his restorative materials. Salesmen are invested with the most persuasive methods available. Claims and guarantees that dare not appear in printed form may be made with safety by an office pest. All of the certifications, standards, and protections offered by the state or dental association cannot protect the dentist, if he chooses to accept private, oral statements in preference to documented guarantees. Whether the sales propaganda emphasizes a higher price as an assurance of higher quality, or the savings to be made on a cheaper brand

claimed to be just as good, the dentist should realize that such unsupported claims are worthless. The code of every salesman need not be expected to equal that of the dentist. The investments, assets and liabilities are frequently quite different. The dentist who lowers his code to do business with any salesman is "off the beam."

A more pleasant and more stimulating obligation of the professional man is that of advancement with the profession. This brings the assurances of being able to make the correct decision and to render the most effective service. Few professions maintain better services than those supplied by the American Dental Association and its component organizations. Texts and journals are available in abundance. Special services are supplied as needed. The Research Commission of the American Dental Association has affiliations which enable it to prove or to disprove statements regarding technics; to test restorative materials; and to list, by trade name, those materials which are known to be safe. The Council on Dental Therapeutics guides the profession safely through the allurements of periodic exploitations, past noisy enthusiasms, and over the entangling confusions always associated with real or imaginary developments in the field of dental therapy. The honorary and specialized organizations offer many additional opportunities for the enhancement of the professional status.

Thousands of American dentists have acquired and are demonstrating truly professional qualities. Indeed there are reasons why American dentists are rated the best in the world.

AMELOGENESIS

A HISTOLOGIC STUDY OF THE DEVELOPMENT, FORMATION AND CALCIFICATION OF THE ENAMEL IN THE MOLAR TOOTH OF THE RAT¹

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INTRODUCTION

There is perhaps no more confused and controversial field in the whole realm of dental histology than that which concerns the precise elaboration of the enamel. The literature is contentious and contradictory. Such confusion is fully understandable and would seem to rest in the nature of the harsh treatment necessary for the preparation of dental tissues prior to histological observation. It is obvious that the use of strong acids for purposes of decalcification may not only distort and macerate the finer cellular elements but may also alter the tinctorial reactions of the tissues on which histochemical determinations depend. Under these conditions interpretation is notoriously difficult and misleading and in consequence has given rise to schools of opinion often directly opposed to one another.

In addition, our knowledge of the mode and process of calcification of the enamel is extremely scant. Biochemical aspects aside, the histologist is dependent for the most part on indirect evidence in his attempts to define the direction and mode of calcification.

¹ Supported by a grant from the American College of Dentists to the University of California, College of Dentistry, Operative Division, and conducted in the Division of Anatomy, University of California Medical School, San Francisco.

There can be but little certainty with such indirect methods and it is not perhaps unjust to say that the greater part of expressed opinion on this aspect of the enamel problem is largely conjectural. The problem of enamel formation and its calcification, because of its basic nature, is one of the most pressing of dental histology and pathology and its solution is a matter of great urgency.

The purpose of this paper is to present some aspects of the development, formation and calcification of the enamel derived from the use of more delicate, precise and direct techniques than those hithertofore employed. It has been the practice for a number of years of one of us to cut thin sections of bone without decalcification. This allows positive staining of the bone salt and in combination with a counter stain, observation of the precise relationship of the calcium complex to the cellular elements. The procedure is almost identical to that described by McLean and Bloom⁶⁷ in their excellent studies on the calcification and ossification of bone. The application of such a method to the study of enamel formation and calcification has the additional advantage in that, apart from establishing the positive relationship between calcium deposition and cellular activity, the avoidance of all acids discloses a number of important morphological details which are otherwise destroyed. The work has in addition enabled us to harmonize a number of otherwise conflicting details and interpretations. A preliminary report^{75, 76} of these findings was presented at the meeting of the International Association for Dental Research, March 15 and 16, 1940, at St. Louis, Mo.

MATERIAL AND METHODS

The material for this investigation consists chiefly of the developing first and second upper molars of young rats of the Evans-Long strain, the mothers of which were maintained on a full and liberal diet with supplementary cod liver oil. Development of the enamel was followed from the 17th or 18th day of gestation to the 15th or 16th day after birth. In this strain the upper first molar erupts on the 13th or 14th day and the second on the 15th or 16th.

The procedure employed for the preparation of undecalcified material was as follows: The alveolar process and contained tooth

follicles or in older animals, the tooth follicles alone, were dissected out with aid of a binocular dissecting microscope and promptly fixed in 10% formol solution neutralized by keeping over an excess of MgCO_3 . After fixation for twenty-four hours, dehydration, without preliminary washing, was commenced with 70% ethyl alcohol and continued by 5° steps to absolute alcohol and ether. All alcohol employed was neutralized with a solution of NaHCO_3 and its pH tested. It was found that MgCO_3 as described by McLean and Bloom⁶⁶ was inadequate for this purpose. From alcohol-ether the tissue was infiltrated at 56° C for twenty-four hours successively, in 10%, 25% and 50% low viscosity nitrocellulose and finally embedded in 50% nitrocellulose solution (Koneff & Lyons).⁵⁴ The nitrocellulose is allowed to harden slowly in a covered embedding dish at room temperature for several days, loosening the margins from time to time as the nitrocellulose contracts. The block is trimmed and allowed to harden further, as an extremely hard block is essential for success with thin sections.

Sectioning is carried out with a heavy wedge knife of hard steel and a short bevel on a sliding microtome, using neutralized 80% alcohol as a lubricant. Frequent honing of the knife is necessary and for best results the edge must be changed after every 4 or 5 sections. It was possible to cut some of the younger material at 3 μ but 5 to 6 was optimum. After mounting on albuminized slides, the nitrocellulose is removed by means of oil of cloves, three changes of absolute alcohol and carried through neutralized alcohol to water. To avoid loss of calcium, the sections should be stained immediately.

For demonstration of calcium Von Kóssa's silver nitrate technique is employed. The sections are placed in 0.25 to 0.5% silver nitrate solution in the dark for an hour and washed in the dark with several changes of distilled water and then exposed in distilled water to sunlight for thirty minutes to one hour. A 2% solution as recommended by McLean and Bloom⁶⁷ was found to give less precise results. As with all silver routine, all glassware should be chemically clean to avoid precipitates. Haematoxylin (Harris) or Haematoxylin and Eosin are employed as counterstain and final mounts are made in Euparal (Grübler). For a discussion of the specificity of

the silver technique in the staining of calcium, the reader should consult the papers of Cameron,¹⁷ McLean and Bloom,⁶⁷ and Bloom and Bloom.¹² Comparative material was fixed in formol, Zenker-Formol, Champy and Bouin's solution and decalcified in 5% HNO₃ in 80% alcohol. A small amount of control material was run by the Altmann-Gersh³⁸ freezing-drying method but showed no very significant differences as to the calcium distribution or loss. In both routine and undecalcified material a wide variety of stains were employed such as Mallory-Azan, Masson's Trichrome, Iron-Haematoxylin, Unna's¹⁰⁵ special stains for skin elements, keratohyalin and eleidin and Kolatchev-Nassonov, Da Fano and Altmann's aniline fuchsin for Golgi apparatus and mitochondria, and others.

In the tissue culture experiments, tooth buds obtained from fetuses on the 18th, 19th and 20th day of gestation and from newborn animals were dissected from their crypts and planted in Carrel flasks and in hollow ground slides. The media employed were chicken plasma or heparinized rabbit serum together with embryonic extract from the chick of seven days' incubation. Tyrode solution or glucosol was used as a supernatant fluid. The cultures were explanted every 48 hours. The whole tooth cultures were maintained for varying periods and some for as long as 82 days. In some cultures, an advanced degree of enamel formation occurred. In a few instances hanging drop cultures were made chiefly for the examination of fragments of living enamel epithelium and pulp. Littermates from this series served as controls.

AMELOGENESIS

1. *The Enamel Epithelium:* In the molar tooth of the rat, the earlier stages of differentiation of the enamel organ into the external and internal enamel epithelium, stellate reticulum and stratum intermedium are similar to, if not identical with the process seen in many other animals and in man. In day old rats of the strain used in these experiments, mitosis is still active in the cells of the internal enamel epithelium of the second molar but has almost ceased in the first. In the first molar at this age, an occasional

mitotic figure may be formed in the less well differentiated cells lying towards the nonapical portion of the active enamel layer. It is well known that amelogenesis does not begin until mitosis has ceased, and we have never observed, apart from Hertwig's sheath, mitotic figures, once enamel has made its appearance. In the rat a minute amount of enamel may be formed in the first molar by the first day, but its establishment is more usually delayed until the second day after gestation. There is approximately a two or three-day lag in the degree of development between the first and second molar.

The internal enamel epithelium, just prior to the establishment of the enamel, differentiates into two distinctive types of cells; (1) the well known true enamel cell, ameloblast or ganoblast and (2) a cell which has not, we believe, been clearly recognized and which we have designated as the enamel supporting cell or kionoblast.¹¹ The latter cell initiates enamel formation by the establishment of the dentino-enamel junction and will, therefore, be described first.

2. *The Supporting Cell or Kionoblast and the Dentino-Enamel Membrane:* The establishment of the enamel and its matrix commences with the formation of the dentino-enamel junction. This zone is more than a simple line of physical contact between enamel and dentine. The ameloblasts at first lie in contact with the underlying layer of differentiating odontoblasts with which they are often somewhat imbricated, giving rise to the well known irregular, wavy appearance frequently exhibited by this junction. They are, however, separated from the odontoblastic layer by the appearance of a delicate and strongly basophilic membrane, the dentino-enamel membrane (the membrana praeformativa or limitans of other authors). This membrane is derived from and continuous with the terminal extremity of a specialized sustentacular cell of characteristic morphology and staining reactions which we shall call the enamel supporting cell or kionoblast. (Fig. 1.)

In the earlier stages of amelogenesis the supporting cell is found singly or in groups of as many as four or five, at irregular intervals

¹¹ Kionoblast from the Greek *Κίων* (ovos) a pillar and *βλαστός* a germ.

between the ameloblasts. A more slender cell, its nucleus is narrow and compact and its cytoplasm finely granular but more uniform and with routine stains, more basophilic in reaction. It is more difficult to distinguish the kionoblast from the ameloblast in later stages, but it is readily recognized by its distinctive coloring with Mallory-Azan, when nucleus and cytoplasm contrast by their red and orange coloration, respectively, with the purple and pale blue of the ameloblast (Fig. 2). In earlier stages, as the dentino-enamel membrane is laid down, the cytoplasm with Mallory-Azan is deep blue as is also the membrane, but the nucleus retains the tinctorial reaction of the older cell. (Fig. 1.)

The dentinal extremity of the cell presents in sections a dichotomous appearance and is continuous with the dentino-enamel junction which it lays down by fusion of its processes with those of other cells (Fig. 1.) At its peripheral extremity it rests upon the more delicate basement or external limiting membrane to which it also seems to give rise although this is less definite.

The kionoblast appears to be of epithelial origin, modified for support. Such modification of epithelial cells into sustentacular elements occur in other epithelial tissues as for example in the organ of Corti.

The dentinal surface of the dentino-enamel membrane gives attachment to von Korff's fibers and may therefore be regarded as an attachment apparatus (Fig. 1). As the predentin is formed, the opposed cell membrane of the ameloblast begins to thicken and by fusion with its fellows, forms a layer on the enamel surface of the membrane (Fig. 3). When the predentin approaches a thickness of from 10 to 13 μ of which about 3 to 4 μ have by now undergone calcification to form true dentin, the limiting membrane is further thickened and becomes more strongly basophilic in reaction. The adjacent lateral borders of the ameloblast participate in this change and are bent over to lie almost parallel with the surface and by fusion, extend the thickness of the layer to from 1 to 2 μ .

The combined layer exhibits further characteristics in that it rapidly undergoes calcification of a density greater than that of the

rest of the future enamel (Fig. 4), so that its individuality is still recognizable after the full thickness of the enamel has been laid down. The calcification is of peculiar coarseness, the calcium particles being intermediate in size between those of the enamel and dentin.

Later, as the enamel is formed, the sustentacular cell or kionoblast becomes incorporated in the matrix and may give rise to the so-called enamel spindles, tufts and lamellae, depending upon whether the cells have arisen singly, in parallel or diverging groups.

3. *The Ameloblast*: Although this paper is concerned primarily with the formation of the enamel matrix and its calcification, there are several features in the cytology of the ameloblast which deserve attention. As the preservation of the cytoplasm of these cells is more perfect in undecalcified material than in tissues which have been subjected to the rigors of acid decalcification, details otherwise obscure are rendered more apparent.

The earliest evidence of cellular activity preceding the matrix formation is an increasing granulation of the cytoplasm followed by the appearance of a large terminal vacuole juxtaposed to the dentino-enamel membrane (Fig. 3). This vacuole appears as the nucleus commences to retreat to the basal¹¹¹ end of the cell which it has not yet reached. In point of time, its origin is closely associated with the reversal in polarity and expansion of the Golgi apparatus and it heralds the first appearance of that portion of the enamel matrix which is deposited on the surface of the dentino-enamel junction. In addition, as will be discussed later, the terminal vacuole is the progenitor of the so-called Tomes' process.

A further striking cytoplasmic change which appears as the ameloblast approaches full functional activity, is the development of an ovoid group of granules at the basal extremity of the cell (Fig. 5 and Fig. 6). These granules occupy the interval between the nucleus and the basement membrane. A negative image suggesting their presence may occasionally be found with routine stains.

¹¹¹The term "basal" is used throughout with reference to the direction of functional activity. The term has been more usually employed to describe the morphological relationship and orientation of the ameloblast with respect to its origin from the dental lamina.

Following treatment with osmic acid, they appear as a small brown or black globule as observed by Beams and King.⁵ We have only been able to obtain positive staining with Masson's trichrome stain when the granules taking the Ponceau de Xylidine show up as a finely granular, irregular ovoid mass of from a quarter to half the size of the nucleus. The granules are fine and compare with those of the neutrophil. Their concentration is variable, the granules being exceedingly numerous in some cells and more discrete in others as to suggest a fine meshwork. The question naturally arises as to whether positive staining of either the Golgi apparatus or of mitochondria has been obtained. The position of the collection, observation of the negative Golgi in the same cell and positive staining of the Golgi in similar material demonstrates a complete lack of any spatial relationship between the two. Likewise their form, size and distribution do not conform to the appearances of mitochondria obtained in control material specifically stained with osmic acid or with Altmann's aniline fuchsin.

The basal granules make their first appearance only after the ameloblast begins to approach its maximum length and some enamel has been laid down. They are most prominent in the rat's first molar on the sixth day when the cells are tallest and after this time become less prominent. By the tenth day, when the cells are considerably reduced in length, the granules are sparse or may be absent. In less well fixed material or in preparations which have undergone the rigors of ordinary decalcification they may not be found or when present, stain as a homogeneous, slightly refractile mass so that the granular form is not so apparent. We have no suggestions to offer as to their functional significance except to observe that their full development is to some degree, evidence of high activity of the ameloblast.

THE ENAMEL MATRIX

1. *The Pre-Enamel Processes:* Immediately after the establishment of the dentino-enamel membrane the formal elements of the enamel matrix commence to make their appearance. Deposition of the matrix is heralded by the development of the large terminal vacuole of the ameloblast already mentioned (Fig. 3). The

cell membrane immediately distal to the terminal vacuole begins to thicken where it lies in juxtaposition to the dentino-enamel membrane which undecalcified preparations disclose, has already begun to calcify. This thickening is due to the laying down of a strongly basophilic hyaline material on the surface of the dentino-enamel membrane. Shortly thereafter a similar material is deposited on the surface of the lateral walls of the cells extending in some measure into the intercellular intervals as an interprismatic layer. The deposit is confined to the lower half of the vacuole thus giving the cell a tapered appearance and converting the vacuole to the shape of an inverted pear.

In the more fully developed stage, this substance assumes its characteristic form as delicate, parallel processes extending peripherally on either side of the cell to merge by their apices, with the cell membrane of the ameloblast. We have termed these structures, which we believe have hitherto escaped observation, the pre-enamel processes (Fig. 7).

The pre-enamel processes vary in length from 3 to 12 μ . They are highest at the apices of the crown or where enamel formation is proceeding rapidly. Under the lower powers of the microscope these processes may be observed constituting a distinctive layer lying between the formed enamel matrix and the clear zone of vacuoles at the extremity of the ameloblast and they always occupy a position in advance of the region of active calcification. The processes possess a selective affinity for the basophilic dyes. With dyes such as those of Unna,¹⁰⁵ etc., the processes exhibit tinctorial reactions characteristic of eleidin. A striking differential staining of these processes is obtained with the use of the Mallory-Azan method in undecalcified preparations. Here, the acid content of the fluids employed acts as a sufficiently gentle decalcifying agent. The processes selectively take the aniline blue and can be sharply distinguished from the formed enamel matrix which stains red with the acid fuchsin. They are destroyed by the usual severe acid treatment or in specimens showing more than a minimal degree of shrinkage, and therefore cannot be displayed in routine preparations.

The zone of the pre-enamel processes should be regarded as the

true pre-enamel which is to be distinguished from the clear area of vacuoles often, but erroneously referred to as such.

2. *Specific Secretion Granules*: The appearance of the pre-enamel processes converts the distal end of the ameloblast into a hollow cylinder the walls of which taper somewhat proximo-distally. The central core of the more proximal part of the cylinder is occupied by the terminal vacuole of the ameloblast which is studded with minute, highly refractile granules (Fig. 8). These granules, spherical in shape, can only be resolved with the highest powers of the microscope; they are likewise, basophilic in reaction. They are more numerous distally and more discrete proximally and may be found occasionally in the series of succeeding and secondary vacuoles which form behind the terminal one, beyond the line of pre-enamel processes. These granules are not to be confused with the occasional larger spherules found in the distal part of the ameloblast and named, we believe incorrectly, calcospherites. These granules stain with specific stains for keratohyaline¹⁰⁵ and they make their first appearance as the content of the terminal vacuole just prior to the initial deposition of basophilic hyaline on the surface of the dentino-enamel membrane. The granules we believe to be the specific secretion granules of the ameloblast from which the pre-enamel processes and the enamel matrix are derived.

3. *The Hyaline Enamel Rod*: Soon after the formation of the pre-enamel processes, the body of the ameloblast beyond the terminal vacuole commences to undergo a similar hyalinisation to form a solid cylinder (Fig. 9) which is not at first, however, so strongly basophilic in reaction as the surrounding walls which constitute the base of the pre-enamel processes. It is this arrangement which enables the observer to detect the minute amount of basophilic interstitial substance intervening between the series of hyaline rods. The progressive hyalinisation of the distal part of the cell establishing the organic structure of the enamel rod is most clearly seen in preparations sectioned in the undecalcified state and secondarily decalcified on the slide after staining with weak acid alcohol or with the use of acid stains (Fig. 10). Such a method precludes damage to the delicate pre-enamel processes.

In certain orientations the hyaline rods of the rat's enamel are crossed giving rise to a lattice-like arrangement (Fig. 11).

4. *The Terminal Bar Apparatus:* In undecalcified material where fixation is good and shrinkage almost absent, we have never observed the so-called terminal bar apparatus (Fig. 7). We have often seen this structure where fixation is less perfect, after acid decalcification or in undecalcified preparations where shrinkage and separation has occurred. When present it assumes either a delicate linear form resembling a basement membrane (See Figs. 9 and 12) or is seen as a series of prominent thickenings or dots between the cells (Fig. 13). It is always basophilic in reaction. We believe that the terminal bar apparatus is entirely an artifact produced by the rupture and partial solution of the pre-enamel processes which retract into the intervals between the cells, to appear as a series of dots and when seen as a linear pseudo-membrane, these processes have undergone partial dissolution and displacement.

5. *Tomes' Processes:* The extensions of the cell protoplasm in the region of the terminal vacuole into the core of the pre-enamel rod constitutes the well known processes of Tomes'. In preparations which have been subjected to more rigorous, though controlled decalcification so as to remove the pre-enamel processes leaving the core intact, we have been able to trace unequivocally, continuity between these protoplasmic processes and the hyalinised enamel rod (Fig. 9). If the shrinkage is more than minimal or the acid decalcification sufficiently severe as to cause partial dissolution of the enamel matrix, the processes rupture and produce the conical projections which have so frequently been illustrated as Tomes' processes (Fig. 13). Therefore, the appearances so often observed are artificial, caused by shrinkage and the structure known as Tomes' process is not conical in form but almost cylindrical and in direct continuity with the organic enamel rod. It arises the moment the terminal vacuole appears with the initiation of enamel formation (Fig. 3) and corresponds to the more distal part of this structure whose walls and content are in a state of partial hyalinisation.

6. *Structure of the Enamel Matrix:* As described above, we

have been able to disclose that the formation of the enamel matrix commences with the laying down of a strongly basophilic hyaline substance on the surface of the cell membrane, establishing the structures termed the pre-enamel processes. It has been observed that behind the level of these processes the central core of the cell becomes hyalinised and progressively more basophilic in reaction. In the older enamel matrix it is difficult to determine any underlying structural elements, and in routine preparations, as is well known, the organic matrix appears to be utterly homogeneous and devoid of structure. In undecalcified preparations in which decalcification of the section is carried out under microscopic control to expose the matrix (Fig. 10) or in which the acid content of the dye alone results in decalcification, the structural basis of the matrix can be determined. We have been able to trace the cell membrane of the ameloblast throughout the entire thickness of the enamel. The membrane can be distinguished with but great difficulty in preparations stained with haematoxylin and eosin and then only if the stain is sharply differentiated. The membrane is however, more sharply defined in Mallory-Azan preparations when it differentially stains blue in contrast to the red of the hyalin substance. Its structural basis is likewise well disclosed with Masson's trichrome stain. (Fig. 14.)

Further notable characteristics of the enamel matrix are its progressive alterations in tinctorial reactions with age, the strongly basophilic young enamel becoming more and more eosinophilic and when fully mature, almost chromophobe. Particularly striking differential effects may be obtained with Mallory-Azan, the pre-enamel processes and initial matrix staining blue, the fully developed matrix, red and the fully matured enamel, orange. These tinctorial reactions are characteristic of a maturing keratin. Similar and distinctive differential staining is obtained with Masson's trichrome method, identical with those obtained in the stratum corneum of the skin.

7. *Reduction of the Ameloblast, Formation of "Calcospherites" and Nasmyth's Membrane:* Reduction of the ameloblast is associated with changes indicative of a more generalized hyalinisation

of the cell. In the first molar the ameloblasts by the tenth day are considerably reduced, their nuclei are becoming progressively more pyknotic and a greater number of large secondary vacuoles appear. The pre-enamel processes are reduced in length and may not be present as such, as the matrix is deposited more uniformly (Fig. 15). Unusual numbers of secretion granules are to be found within the secondary vacuoles. As reduction continues these granules fuse to form the so-called "calcospherites" which now begin to be found more frequently. The presence of "calcospherites" is evidence that the ameloblast is entering the final stages of enamel formation and that its functional activity is on the wane. These bodies are found most commonly in those cells which occupy the future intercuspul sulci (Fig. 16).

The "calcospherite" constantly exhibits tinctorial reactions identical with those of the pre-enamel processes and early matrix, and we conclude that like them, they are composed of eleidin. At no time during their formation have we been able to obtain positive staining of calcium within their substance. We, therefore, prefer to discard the term "calcospherite" as misleading and on the basis of their formation and histological reactions, employ the term *hyaline or eleidin globules*.

The final stage of matrix formation differs from the earlier in that the process of hyalinisation extends somewhat abruptly throughout the remainder of the reduced cell and is no longer confined to its terminal extremity (Fig. 15). The pre-enamel and Tomes' processes are no longer present. The cell nuclei, more pyknotic than ever, are incorporated in this final layer (Fig. 17). Hyalinisation may extend to the stratum intermedium, a process which is preceded by the appearance of keratohyaline granules in the cytoplasm of these cells. Keratinisation has been most frequently observed in that portion of the stratum intermedium overlaying the apices of the crown.

The quality of the enamel matrix deposited in this fashion differs somewhat in texture from the rest of the enamel owing to the rapidity with which it forms. It therefore exhibits a less definite formal structure, appears more homogeneous and reveals the pres-

ence of ghost nuclei in its substance. Calcification of the layer is delayed and may not occur before eruption. It is this surface layer which constitutes Nasmyth's membrane with which incompletely keratinized cells of the stratum intermedium may be incorporated.

8. *Calcification of the Enamel Matrix:* In thin, 4 to 6 μ undecalcified sections of developing enamel, the details and direction of calcification can be followed in unequivocal fashion by positive staining of the deposited calcium complex with silver salts. The method is precise and exact and yields exquisite pictures of the process.

Calcification of the enamel matrix begins in the dentino-enamel membrane almost as soon as this structure is established as a definitive layer (Fig. 4). The calcium is laid down in the form of small granules intermediate in size, between those of the dentine and the enamel. The calcium density of this layer rapidly increases and up to the time of eruption, the density of this layer exceeds that of both the remaining enamel and of the dentin.

Calcification of the enamel rods and interprismatic substance commences as soon as the central core begins to undergo hyalinisation. The calcium granules are exceedingly minute being much smaller than those forming the dentine or bone. This minuteness of size of the initial calcium crystals is a characteristic of the enamel which no doubt accounts for its physical properties. The crystals may grow in size until they fuse by coalescence or may be deposited in such numbers as to form a uniform mass.

The calcium is first deposited upon the lateral walls of the hyaline rod and the disposition extends peripherally as far as the base of the pre-enamel processes (Fig. 8). The calcified rod in the early stage or in those portions still undergoing calcification, appears as a cylinder whose wall is solidified by the calcium complex and whose core is filled with hyaline. Therefore in section, the rod at the margin of advancing calcification, presents the appearance of parallel calcified processes between which lies an uncalcified core. The core itself commences to calcify a little later than the walls by the laying down of calcium of similar small granules. These may fuse to form larger granules but the density of the core is never quite as great as that of the margins of the rod.

Calcification of the interprismatic substance begins slightly behind the level of the newly calcified rod. The calcium is likewise deposited in finely granular form which also undergoes coalescence to form larger particles. Uncalcified interprismatic intervals, however, persist for some considerable time before the whole enamel becomes solidified.

Calcification of the enamel definitely progresses from the dentino-enamel membrane towards the surface (Fig. 18), gradually increasing in density as the enamel matures. Selective decalcification of the section under direct visual control, confirms these findings as the calcium is progressively removed from the periphery towards the dentino-enamel junction (Fig. 10). In this manner the structure of the fully calcified enamel otherwise too dense for microscopic analysis, can be revealed.

The nature of Shreger's lines is beautifully shown in the undecalcified material where they can be seen to be formed by the alternate change in direction of groups of enamel prisms (Fig. 18, Fig. 19).

As already pointed out, we have obtained no evidence of the inorganic calcium salt existing as such in the ameloblast or its contained structures. However, it has been noted that after staining with silver salts, the ameloblastic layer may uniformly take on a yellow coloration which increases in depth of hue progressively from the stratum intermedium towards the enamel end of the cell. The concentration of color is quite high at the base of the terminal vacuole. A similar tinctorial reaction occurs in the odontoblastic layer during the formation of the dentin. This reaction to the silver salt suggests the presence of calcium, possibly in diffusible form, concentrated at these levels and would indicate further that the calcium of the enamel is derived from the tissue juices of the surface cells.

DISCUSSION

The literature on amelogenesis is so extensive and the opinions expressed so much at variance with one another, that in order to prevent this account from becoming prolix, we have limited this discussion largely to our own findings but with occasional reference to

the observations of other authors. We fully realize that several of the features herein reported have been noted by previous writers, but for the most part unrelated to the comprehensive picture, or as a very incomplete basis for the erection of some hypothesis on enamel formation.

It has long been appreciated that the rigors of decalcification, fixation and dehydration are prone, particularly in the examination of tooth structure, to produce artifacts. The technique which we have employed has avoided the destructive effects of acid decalcification and rendered possible not only the positive staining "in situ" of the calcium complex, but also has provided histological material which reveals details establishing, with some precision, the mode and development of the enamel. Fixation has been limited to immediate immersion of the specimen in neutral formol and the possible creation of artifacts by alcohol dehydration controlled by comparison with like material dehydrated "in vacuo" at low temperatures (Altmann-Gersch technique).³³

In the rat the dentino-enamel junction or preferably the dentino-enamel limiting membrane, is a positive structure laid down by the branching processes of a specialized supporting cell, the kionoblast, which by giving attachment to von Korff's fibers of the dentin, provides a mechanism not unlike the Sharpey fibers of bone, through which the enamel is firmly attached to the dentin. This membrane is apparently in part the membrana praeformativa of Henle,⁴³ Huxley,^{45, 46} Kölliker^{52, 53} and Studnicka,¹⁰⁰ and the membrana limitans of Held,⁴² Göllner^{36, 37} and Meyer.⁶⁹ On its surface primary deposition of enamel matrix occurs which almost immediately undergoes dense calcification, an arrangement which has no doubt given rise to conceptions such as those of Kölliker,^{52, 53} von Ebner,^{26, 27, 28} Nishimura⁷³ and Schaffer and others that the matrix is deposited as an homogeneous mass.

It is generally accepted that the formation of dentin precedes that of the enamel. Although in general terms this is true, nonetheless a small amount of enamel matrix, in the form of granules, may be laid down on the surface of the dentino-enamel junction just prior to the formation of the dentin. These granules lie on the

surface of the limiting membrane between it and the cell membrane of the ameloblast and in any but the most perfect preparations may give to the enamel cell the appearance of being ciliated. It is probable that this appearance has suggested theories such as those of Studnivka¹⁰⁰ and Prénant.^{84, 85} Fusion of these minute granules forms a narrow primary layer of enamel which is the only portion which can be regarded as homogeneous in the sense of von Ebner.^{26, 27, 28} This layer together with that of the dentino-enamel membrane, is unique in the rapidity and the extreme density with which it calcifies.

The appearance of the large terminal vacuole of the ameloblast containing specific keratohyalinous secretion granules is the earliest indication of the beginning of the structural enamel unit. The deposition of these granules as the pre-enamel processes has not, we believe, been hitherto described. These processes play an essential part in the establishment of the enamel rod, the production of Tomes' processes and the hyalinisation of the interprismatic intervals. We believe that remnants of these processes in less carefully prepared material, are responsible for a number of the appearances described in the literature. With simple separation of the cellular layer from the formed enamel, remnants of the processes may artificially produce the appearances of a membrane on the surface of the enamel. This layer would constitute the *membrana praeformativa* which was in a later stage erroneously identified by Huxley^{45, 46} as Nasmyth's membrane. It corresponds to the *membrana limitans secunda* of Held.⁴² Its presence has been interpreted as evidence indicating the homogeneous deposition of matrix and later as a primary cuticle by Gottlieb.⁸¹

On the other hand, when the cells are pulled away from the enamel, the pre-enamel process retracts into the interval between the cells and lie, as is to be expected, at the base of Tomes' processes. Thus they appear either as a series of regular dots or as a continuous membrane in this situation, long identified as the limiting bar apparatus. In preparations devoid of shrinkage we have never been able to observe either a limiting membrane or terminal bar

apparatus in this situation, and are forced to conclude that certainly as far as the rat is concerned, these structures are artifacts.

Tomes' process is clearly the terminal vacuole of the ameloblast which extends for a little distance into the developing enamel matrix surrounded by the pre-enamel processes. It is that portion of the cell, rich in keratohyaline granules, which has not as yet undergone hyalinisation. The conical projections typically illustrated as Tomes' processes are due to separation but their appearance varies depending upon the nature and degree of perfection attained in preparation. They are in fact in direct continuity with the hyalinized rod and being rich in hyaline granules, may be regarded as the transitional zone between the formed enamel matrix and the ameloblast.

We consider as untenable the views of von Ebner,^{25, 26, 27, 28} Schaffer,³¹ Nishimura⁷³ and Meyer,^{68, 69} which regard the enamel matrix in whole or in part as structureless and homogeneous. Utilizing special stains we have been able to trace the cell membrane of the ameloblast in continuity throughout the entire thickness of the enamel with the exception of the dentino-enamel limiting membrane and the final cuticular surface layer of Nasmyth.⁷² Our studies, therefore, substantiate and confirm older conceptions of conversion.

The enamel rod is virtually a hyalinized ameloblast. Hyalinisation has proceeded in an orderly and progressive fashion with the initial appearance of the specific secretion granules which are deposited as the pre-enamel processes and, behind these processes, they contribute to the solidification of the cell. The hyalinized cells are united by a small amount of cementing or interprismatic substance, which arises in association with the pre-enamel processes and which extends through the membrane wall into the intercellular intervals. The interprismatic substance is therefore essentially similar material to that which is both deposited as the pre-enamel process and replaces the cytoplasm of the cell. As the enamel matrix ages, it undergoes histo-chemical changes no doubt related to calcification, the significance and nature of which will be discussed anon. There is no evidence to suggest that the matrix is deposited in a series of large, discrete globules as suggested by Williams, Mummery,^{70, 71} Andrews,¹ Lams⁵⁷ and as illustrated by Noyes, Schour and Noyes.⁷⁴

The globular theory would seem to have its inception in the beaded appearance of slightly etched ground sections of enamel and in part from the finding of the so-called "calcospherites" in the ameloblast.

The calcospherite, a term introduced we believe by Harting,⁴¹ 1872, and used to describe the rounded bodies found in the ameloblast, is in the present state of our knowledge, an unfortunate and misleading term. It has been said by Noyes, Schour and Noyes⁷⁴ that they are formed by the fusion of minute "drop-like" pre-enamel granules, which becoming larger as they reach Tomes' process, are deposited one upon the other in the form of a large calcospherite, the enamel globule, to form the enamel prism. The deposition of these globules is said to occur in a regular and rhythmic manner and each globule, according to Asper,⁴ represents a daily increment.

The calcospherite as is to be inferred from its name, is thought¹¹² to carry calcium as a calcoglobulin. There is, however, no evidence to show that these structures are calcium bearing bodies. In undecalcified preparations, positive staining for calcium is absent. On the other hand, specific stains show them to be composed of material identical histochemically, with that of the pre-enamel processes and the hyalinising rod. We have observed that the bodies identified as "calcospherites" do not make their appearance until considerable recession of the ameloblast has occurred and they are common in certain pathologic conditions such as rickets. They are usually more apparent in those cells lining the intercuspul sulci and are related to the rapid terminal hyalinisation associated with the formation of Nasmyth's membrane which they establish by coalescence. The term pre-enamel globule is likewise somewhat misleading and we propose that the calcospherite be referred to from its composition as hyaline or eleidin globule. The distinction between eleidin globule and the specific secretion kerato-hyaline granule, should be noted.

Since Thompson¹⁰³ in 1887, suggested that a keratin was the basis of the enamel matrix, biochemical and histochemical determinations such as those of Rosebury and Gies,⁸⁹ Rosebury,⁹⁰ Karshan⁹⁰ and Pincus,⁸³ have confirmed this view. Chase in a series of ar-

ticles^{20, 21, 22} has advanced evidence based on the use of differential staining reactions which develop this opinion and from which he interprets progressive maturation stages of the enamel matrix. An important parallelism in staining reactions between enamel and the skin is noted. The tinctorial reactions exhibited by our material are in general agreement with those of Chase except as to precisely which of the several components are differentially stained. In addition we cannot agree with the concepts of calcification derived from his study, and can only agree with his conclusion in part and then only in the most general terms. Judging from both text and microphotographs of this author, we believe that the processes of decalcification employed have so disturbed the histo-anatomy as to have caused some confusion as to the nature and position of the interstitial substance.

Histochemical examination of the various components of the developing matrix utilizing specific stains, is strongly suggestive of the chemical nature of the constituents. Our observations disclose that the minute secretion granules occupying the terminal vacuoles of the ameloblast are composed of keratohyaline occurring in much finer form than that found in the stratum granulosum of the skin. Although insoluble in weak acids, keratohyaline is, however, destroyed by strong acids and therefore is not consistently found in decalcified preparations. The pre-enamel processes and hyaline globules, the so-called calcospherites, show reactions which are suggestive of the eleidin of the stratum lucidum. The fully hyalinised matrix conforms in reaction to some type of keratin which tends with age to become progressively more eosinophilic and which may be compared to the stratum corneum. These observations extend the conception of Chase and tend to show an even stronger parallelism between the skin and its products and those of the developing matrix then hithertofore supposed.

It is fully recognized that both ontogenetically and phylogenetically, the enamel is derived from and is but a modified form of the ectoderm. Our observations indicate that the modification of skin into an enamel organ is a far less radical change than is sus-

pected. The ameloblast has preserved its essential and primitive function as a keratin producing cell; its product undergoing some slight chemical or physico-chemical modification, the nature of which is as yet unknown, and from which it derives its affinity for the calcium complex. The progressive changes from the strong basophilia of the pre-enamel processes which do not calcify to the progressive acidophilia of the more fully formed enamel matrix which rapidly calcifies, is similar to the staining reactions of bone in the development of its organic matrix. The changes suggest alterations in the pH related to the deposit of the inorganic salts which is more in conformity with a humoral theory than of one of enamel secretion.

The fundamental changes in the modification of the tegmentary cell to that of the ameloblast is one of orientation rather than of product. In a stratified squamous epithelium, orientation is parallel to the surface. The cell moves towards that surface with progressive functional maturation. In the case of the ameloblast the anatomic orientation is at right angles to the surface and functional maturation extends progressively from one end of the cell to the other. Change in orientation is an important principle, as has been shown by the experimental embryologist, in the elaboration of specialized organs from more generalized tissues.

Our knowledge of the calcification process in enamel is admittedly very scanty (Noyes, Schour and Noyes⁷⁴). Existing theories stated in general terms fall roughly into three categories: first, there are the older views of secretion evolved by von Kolliker,^{52, 53} Legros, and Magitot,^{58, 59} in which it is contended that the enamel is deposited as a more or less finished product; second, there are those, von Ebner,^{25, 27, 28} Kitchin,⁵¹ Chase^{19, 20, 21, 22} and Applebaum,^{2, 3} who maintain that a pre-enamel matrix is the initial element which later undergoes some form of calcification from the tissue juices; and finally, there are those, Buest,^{6, 7, 8, 9, 10} Diamond and Weinmann,²⁴ who combine these two theories in varying degrees and proportions. The evidence for such conclusions is slender and opinion highly inferential depending upon the histological appearances of decalcified

tissue²⁴ and on studies of ground sections by the Grenz^{2, 3} ray or polarized light.¹⁸ It has been most commonly assumed that the mode and direction of calcification can be determined from the histological appearances and staining reactions of the decalcified matrix but such evidence is open to considerable differences in interpretation as for example, in the opposed views of von Ebner^{26, 27, 28} and Chase^{19, 20, 21, 22} on the one hand, and those of Diamond and Weinmann²⁴ on the other. It is not sufficiently realized that the nature of the relationship between the tinctorial reactions of the decalcified matrix and calcification is as yet unproved. Nonetheless far-reaching conclusions in the interpretation of pathological processes, as in the recent monograph of Diamond and Weinmann²⁴ are laid upon such foundations.

The evidence derived from undecalcified, thin sections stained specifically for calcium is unequivocal. The position, sequence and degree of deposition can be followed in detail and with some certainty. In addition, by removal of the calcium under visual control, the tinctorial reaction of the uncovered matrix and its relationship to calcification can be established.

In the rat, calcification of the enamel matrix is progressive, extending from the dentino-enamel junction to the periphery. It follows, as already described, in orderly fashion immediately upon establishment of the dentino-enamel limiting membrane and is preceded by the progressive hyalinisation of the ameloblast. In the formal elements, a denser deposition is characteristically found in the wall of the rods behind which follows a finer type of deposit in the core of the rod and in the interprismatic substance. In addition, the deeper layers progressively increase in density towards the periphery although in the finished form, the density of the surface layers may exceed that of the center, with the possible exception of the dentino-enamel junction. In this respect it should be noted that Karlström,⁴⁰ and Hodge and McKay⁴⁴ concluded from their studies that the surface layers are harder than those of the deeper parts. The matrix, on the other hand, exhibits an increasing acidophilia extending in the reverse direction to calcification, progressing from the uncalcified strongly basophilic zone of the pre-enamel

processes towards the dentino-enamel junction; evidence of a histochemical maturation which is confirmed by selective dyes. These findings agree in some respects with those of von Ebner,^{25, 26, 27, 28} Kitchin,⁵¹ Chase^{19, 20, 21, 22} and Applebaum²³ and are quite contrary to those of Diamond and Weinmann.²⁴ It is important to recognize that the effect of acids employed for the decalcification of enamel is not only to remove the calcium but also to dissolve the matrix whose resistance to solution within certain limits is somewhat variable from part to part. We are not convinced therefore that calcification is a process of substitution of the enamel matrix as has often been stated.

Our studies clearly point to the necessity of divorcing the process of enamel matrix formation from that of its calcification. The product of the ameloblast is fundamentally the enamel matrix and in our opinion, calcification is purely a secondary and humoral process. A number of features support the validity of such a view.

We have found that in "in vitro" cultivation of the tooth, the enamel matrix in some instances may be laid down in substantial amounts without undergoing calcification at all. The matrix undergoes histochemical changes, as evidenced by its progressive acidophilia and behavior to selective dyes, similar to those occurring in the organic matrix of bone during ossification and are typical of such tissue alterations which elsewhere are constantly associated with calcium deposition. There is strong evidence that the calcium salts are derived by diffusion from the periphery and are uniformly distributed through the cell, concentrating at its active extremity, where, far removed from the buffering power of the blood, conditions are suitable for their precipitation in crystalline form. Additional evidence derived from the study of deficiency states, we hope shortly to present in support of this view.

Enamel, therefore, as far as we have been able to determine, is not secreted as such. This is an important concept suggestive of that promulgated by Leriche and Policard⁶¹ which has given rise to so much controversy concerning the status of the osteoblast and its role in the formation of bone. Indeed, we feel that many aspects of the pathology of enamel require reexamination in this light.

We should like to express our thanks and indebtedness to Mrs. L. Philippe Kleinbeitz and Miss Mary Reed for secretarial assistance, to Miss D. Chamberlain and Miss B. Killian for technical help, to Mr. M. Murayama for the color microphotographs, and to Mr. Walter B. Schwarz for the schematic drawing.

SUMMARY

The development of the enamel has been followed in the first molar of the rat from birth to the time of eruption of the teeth and the following observations made:

1. The internal enamel epithelium, just prior to the establishment of the enamel, differentiates into two distinctive types of cells (1) the ameloblast or ganoblast and (2) the kionoblast.
2. The kionoblast initiates enamel formation by the establishment of the dentino-enamel membrane and may give rise to the enamel tufts, lamellae and spindles.
3. The earliest evidence of cellular activity in the ameloblast is an increasing granulation of the cytoplasm followed by the appearance of a large terminal vacuole, the future Tomes' process.
4. A further cytoplasmic change appears in the form of basal granules as the ameloblast approaches full functional activity.
5. Immediately after the establishment of the dentino-enamel membrane and the terminal vacuole, the formal elements of the enamel matrix make their appearance in the form of delicate parallel processes extending peripherally on either side of the cell to merge by their apices with the cell membrane of the ameloblast. These structures are termed *pre-enamel processes*.
6. The appearance of the pre-enamel processes converts the distal end of the ameloblast into a hollow cylinder the walls of which taper somewhat proximo-distally. The central core of the more proximal part of the cylinder is occupied by the terminal vacuole and constitutes Tomes' process.
7. The terminal vacuole is studded with minute, highly refractile granules, spherical in shape, which stain specifically for keratohyaline and should not be confused with the so-called calcospherites. These granules we believe to be specific secretion granules of the

ameloblast from which the enamel processes and the enamel matrix are derived.

8. Soon after the formation of the pre-enamel processes, the body of the ameloblast, beyond the terminal vacuole, undergoes a hyalinisation to form a solid cylinder.

9. The progressive hyalinisation of the distal part of the cell establishes the organic structure of the enamel rod.

10. We have never observed the so-called terminal bar apparatus where fixation is good and shrinkage absent. We believe the terminal bar apparatus is entirely an artifact.

11. The extension of the cell protoplasm in the region of the terminal vacuole into the core of the pre-enamel rod constitutes the well known 'Tomes' processes. If acid decalcification is severe as to cause partial dissolution of the enamel matrix, the processes rupture and produce the conical projections which have frequently been illustrated as 'Tomes' processes. Therefore, the appearances so often observed are artificial, caused by shrinkage and rupture.

12. In undecalcified preparations in which decalcification is carried out under microscopic control to expose the matrix, we have been able to trace the cell membrane of the ameloblast throughout the entire thickness of enamel.

13. The enamel matrix undergoes progressive alterations in tinctorial reactions with age, the strongly basophilic enamel becoming more and more eosinophile and when fully mature, almost chromophobe.

14. Reduction of the ameloblast is associated with changes indicative of a more generalized hyalinisation of the cell. The pre-enamel processes are reduced in length and may not be present as such, as the matrix is deposited more uniformly. Unusual numbers of secretion granules are to be found within secondary vacuoles which fuse to form so-called "calcospherites." The "calcospherite" constantly exhibits tinctorial reactions identical with those of the pre-enamel processes and early matrix. We conclude that they are composed of eleidin and we propose the term hyaline or eleidin globules.

15. In the final stage of matrix formation, the process of hyalin-

isation extends throughout the remainder of the reduced cell. The pre-enamel and Tomes' processes are no longer present, the nuclei become pyknotic and are incorporated into the final layer. Hyalinisation may extend to the stratum intermedium.

16. Calcification of the enamel matrix begins at the dentino-enamel membrane as soon as this structure is established. The calcium density of this layer increases up to the time of eruption and exceeds that of both the rest of the enamel and of the dentin.

17. Calcification of the enamel rod and interprismatic substance commences as soon as the central core begins to undergo hyalinisation. The minute calcium crystals are first deposited on the lateral walls of the hyaline rod, the disposition extending peripherally as far as the base of the pre-enamel processes. The core of the rod calcifies a little later than the walls. The calcium density of the core is never as great as the margin of the rod.

18. Calcification of interprismatic substance begins slightly behind the limit of the newly calcified rod. The calcium deposition in the rod and interprismatic intervals is of a finely granular form. The granules fuse to form large calcium particles.

19. The calcification of the enamel definitely progresses from the dentino-enamel membrane towards the surface, gradually increasing in density as the enamel matures.

20. After staining with silver salts, the tinctorial reactions of the ameloblast indicate that the calcium of the enamel is derived from the tissue juices of the surface cells.

21. Our observations indicate that the modification of the skin into an enamel organ is a far less radical change than suspected and homologies between the various layers of the skin and the stages of enamel formation are drawn. The ameloblast has preserved its essential and primitive function as a keratin-producing cell; its product undergoing some slight chemical or physico-chemical modification, the nature of which is as yet unknown and from which it derives its affinity for the calcium complex.

22. The various stages are illustrated in the composite drawing of Fig. 20.

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AMELOGENESIS

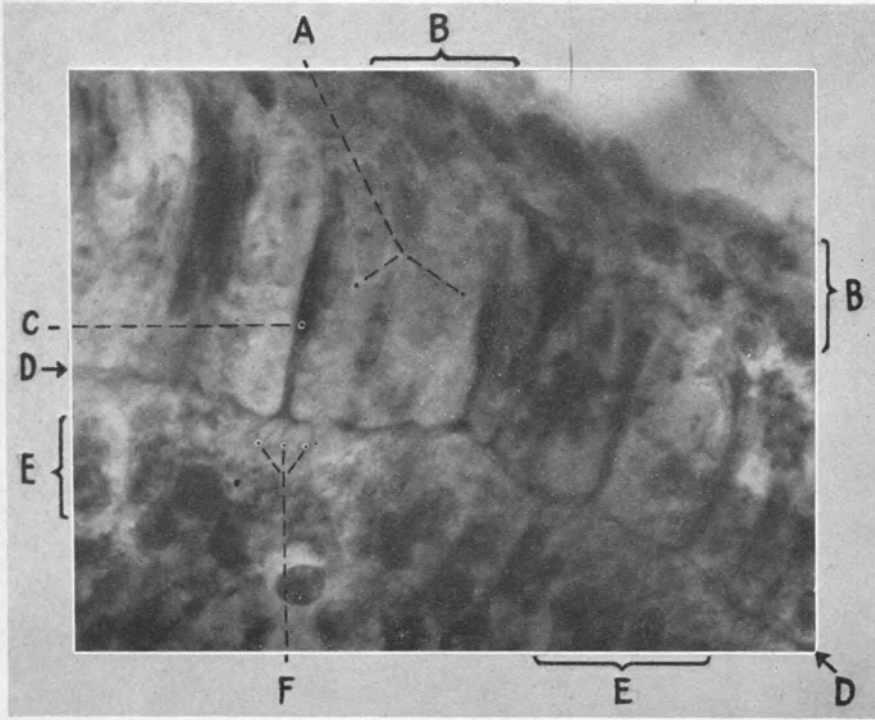


FIG. 1. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED MALLORY-AZAN $\times 1200$ ILLUSTRATING EARLY DEVELOPMENT OF DENTINO-ENAMEL MEMBRANE.

- A. AMELOBLASTS.
- B. STRATUM INTERMEDIUM.
- C. KIONOBLAST.
- D. DENTINO-ENAMEL MEMBRANE.
- E. ODONTOBLASTS.
- F. VON KORFF'S FIBERS.

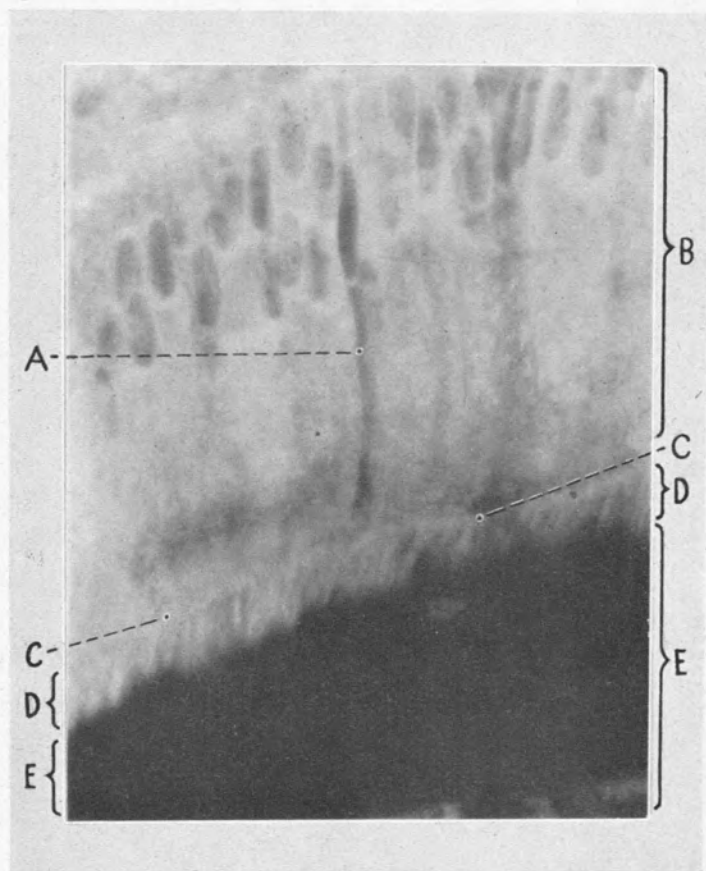


FIG. 2. FIRST MOLAR, 6 DAY RAT, CORONAL SECTION, UNDECALCIFIED MALLORY-AZAN $\times 1200$ ILLUSTRATING KIONOBLAST AT A LATER STAGE.

- A. KIONOBLAST.
- B. AMELOBLAST.
- C. LAYER OF TERMINAL VACUOLES.
- D. PRE-ENAMEL PROCESSES.
- E. ENAMEL MATRIX.

AMELOGENESIS

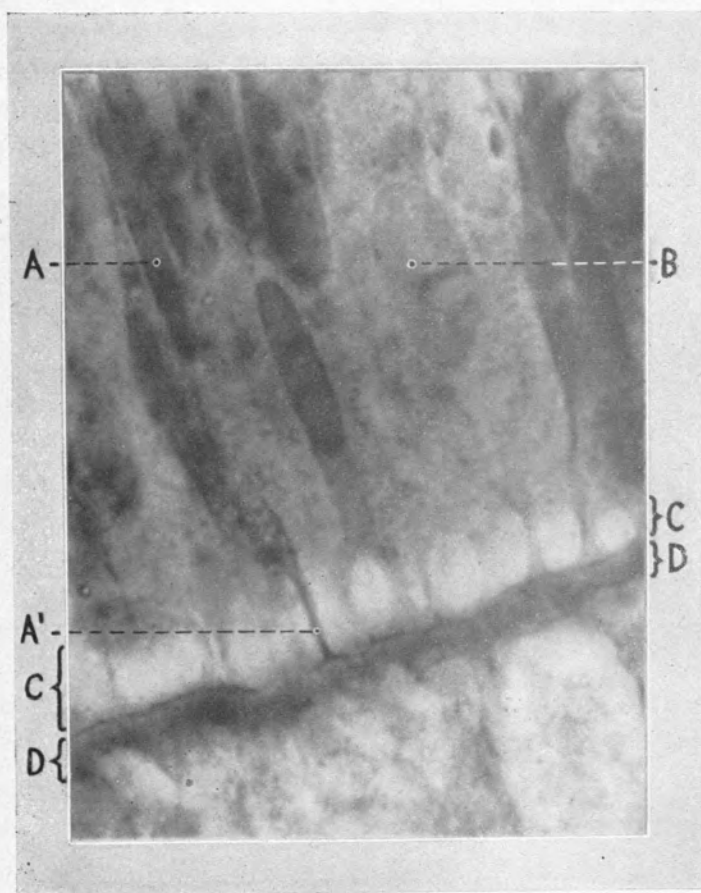


FIG. 3. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED MALLORY-AZAN $\times 3000$ ILLUSTRATING THE TERMINAL VACUOLE.

- A. KIONOBLAST NUCLEUS AND AT A' TERMINAL PROCESSES.
- B. AMELOBLAST.
- C. TERMINAL VACUOLE.
- D. PREDENTINE.

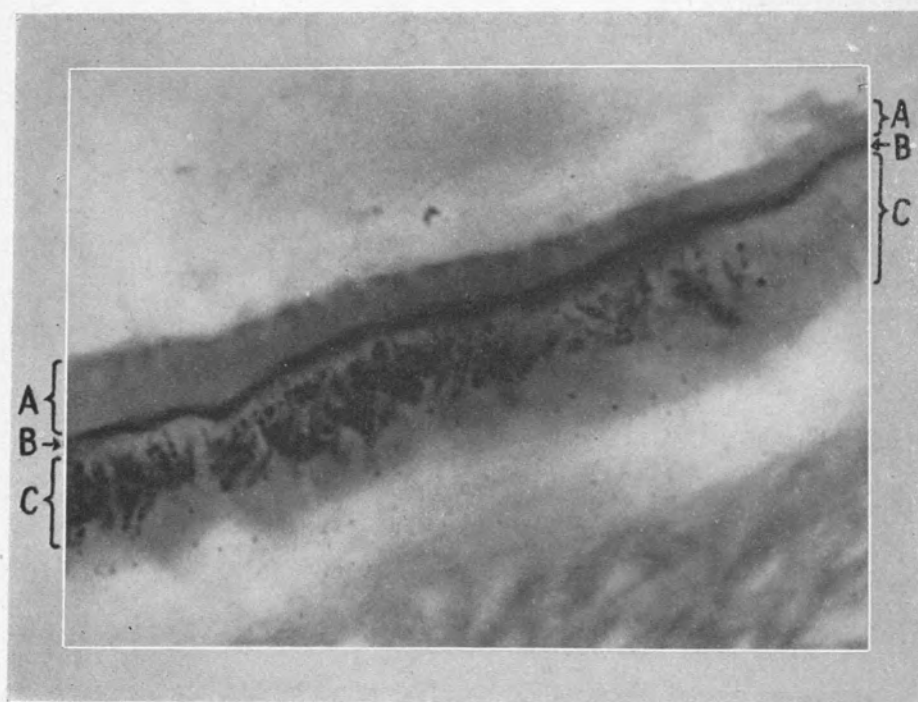


FIG. 4. FIRST MOLAR, 3 DAY RAT. DENTINO-ENAMEL JUNCTION, UNDECALCIFIED, MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 3000$ ILLUSTRATING CALCIFICATION OF THE DENTINO-ENAMEL MEMBRANE.

- A. ENAMEL MATRIX.
- B. CALCIFIED DENTINO-ENAMEL JUNCTION.
- C. CALCIFYING PREDENTINE.

AMELOGENESIS

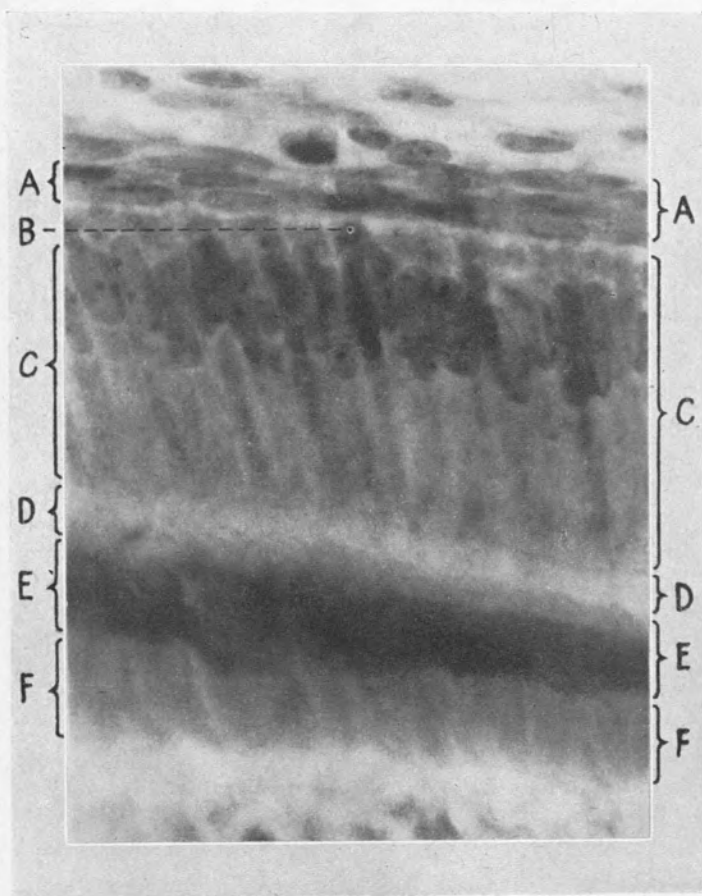


FIG. 5. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED MASSON'S $\times 1200$ ILLUSTRATING BASAL GRANULES.

- A. STRATUM INTERMEDIUM.
- B. BASAL GRANULES.
- C. AMELOBLASTS.
- D. TERMINAL VACUOLES.
- E. ENAMEL MATRIX.
- F. DENTINE.

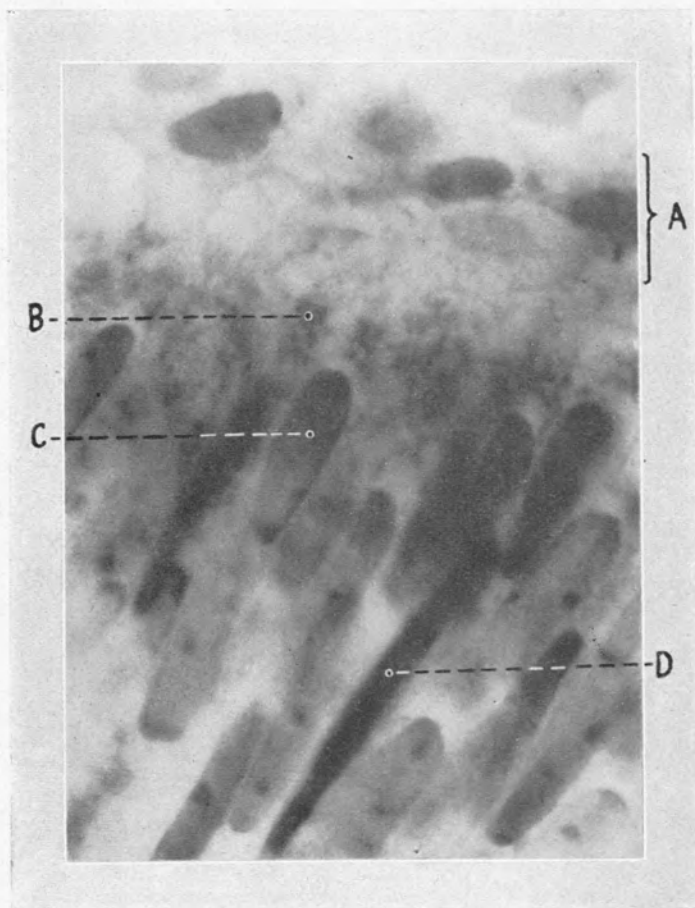


FIG. 6. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED MASSON'S $\times 3800$. A HIGHER MAGNIFICATION THAN FIG. 5.

- A. STRATUM INTERMEDIUM.
- B. BASAL GRANULE.
- C. NUCLEUS OF AMELOBLAST.
- D. NUCLEUS OF KIONOBLAST.

AMELOGENESIS

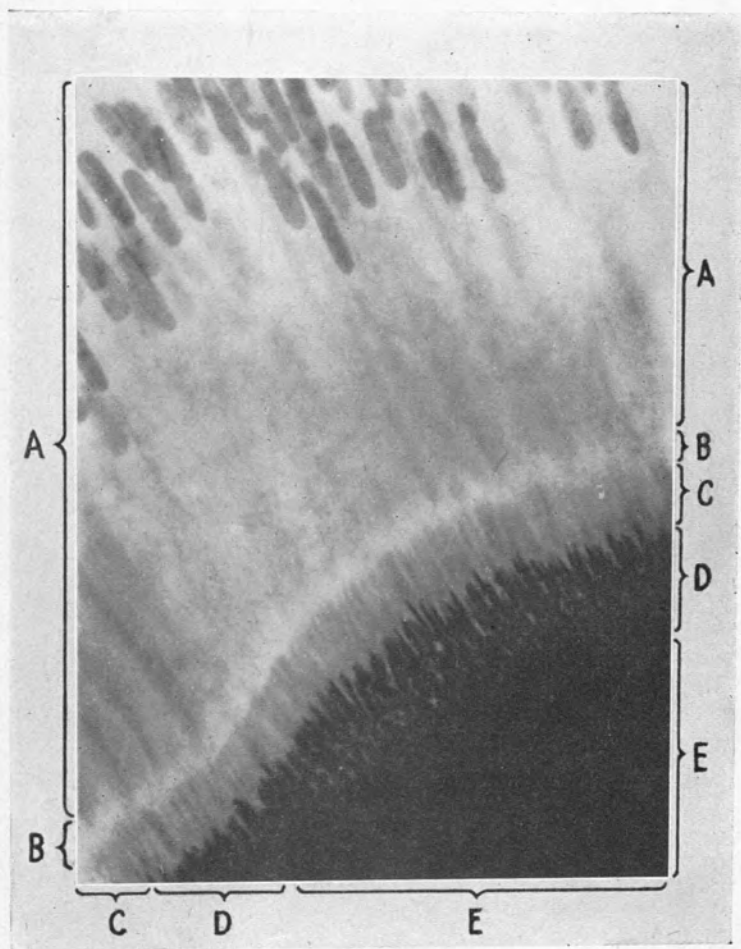


FIG. 7. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED MODIFIED VON KOSSA'S SILVER NITRATE, COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 1900$ ILLUSTRATING FORMATION OF ENAMEL RODS.

- A. AMELOBLAST.
- B. TERMINAL VACUOLES.
- C. PRE-ENAMEL PROCESSES.
- D. CALCIFYING ENAMEL ROD.
- E. FULLY CALCIFIED ENAMEL.

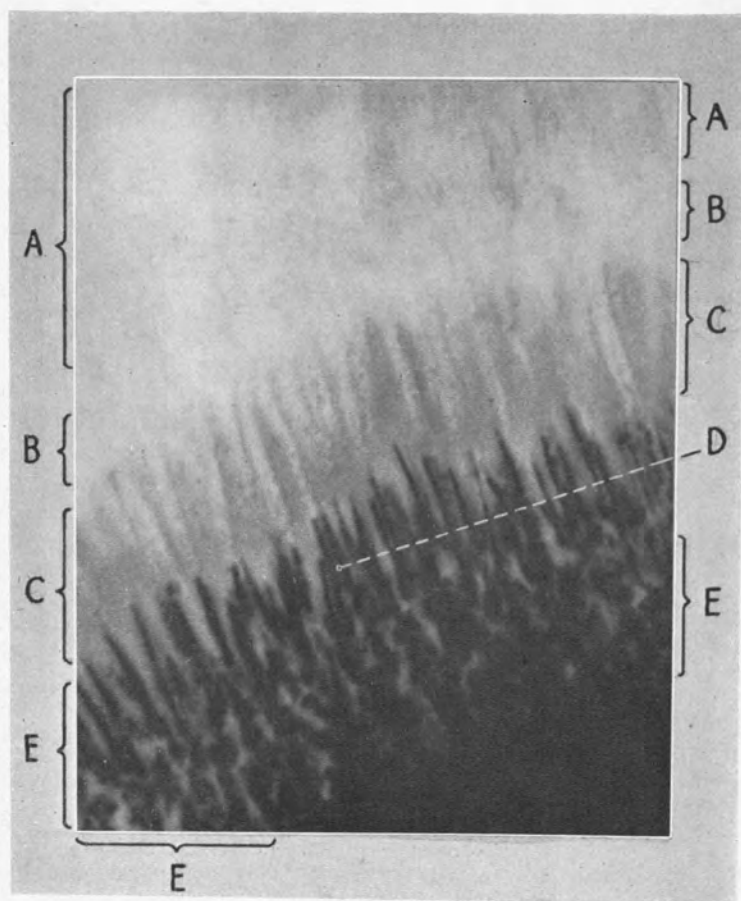


FIG. 8. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN. (UNTOUCHED MICRO PHOTOGRAPH $\times 3800$.)

- A. AMELOBLAST.
- B. TERMINAL VACUOLES.
- C. PRE-ENAMEL PROCESSES.
- D. CALCIFICATION EXTENDING INTO LATERAL WALL OF HYALINISING ENAMEL ROD.
- E. INTERPRISMATIC SUBSTANCE, AS YET UNCALCIFIED SEEN BETWEEN THE RODS.

NOTE THE MINUTE REFRACTILE SECRETION GRANULES IN THE INTERVALS BETWEEN THE PRE-ENAMEL PROCESSES.

AMELOGENESIS

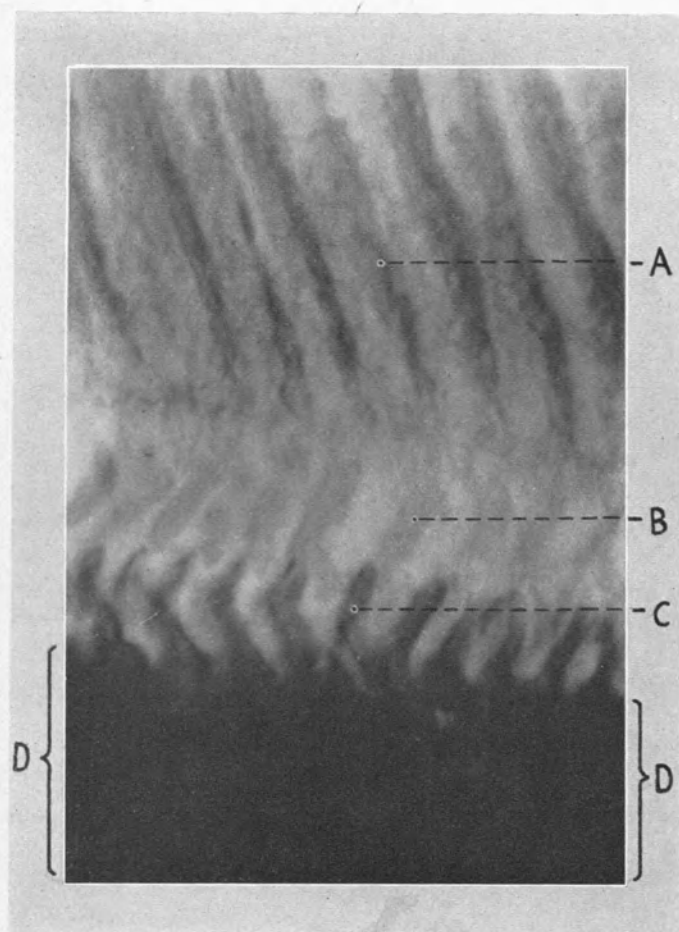


FIG. 9. FIRST MOLAR, 6 DAY RAT, CORONAL SECTION, SECONDARILY DECALCIFIED, MALLORY-AZAN $\times 2800$.

- A. AMELOBLAST.
- B. TOMES' PROCESS IN CONTINUITY WITH,
- C. HYALINISED ROD.
- D. ENAMEL MATRIX.

NOTE THE INTERVALS BETWEEN THE TOMES' PROCESSES DUE PARTLY TO SOLUTION OF PRE-ENAMEL PROCESSES AND PARTLY TO SHRINKAGE. THE APPEARANCE OF A BEND IN THE HYALINISED ROD IS DUE TO THE CROSSING OF THESE STRUCTURES.

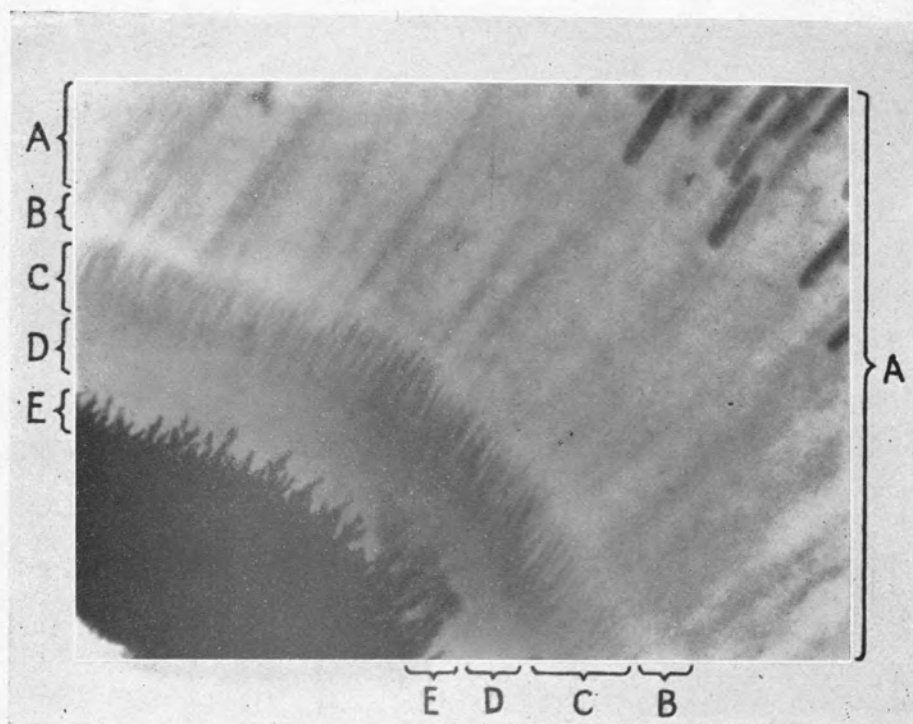


FIG. 10. FIRST MOLAR, 3 DAY RAT, CORONAL SECTION, SECONDARILY DECALCIFIED, MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 2000$.

- A. AMELOBLASTS.
- B. TERMINAL VACUOLES.
- C. PRE-ENAMEL PROCESSES UNDAMAGED.
- D. ENAMEL MATRIX FROM WHICH CALCIUM HAS BEEN REMOVED.
- E. PARTIALLY DECALCIFIED ENAMEL RODS.

AMELOGENESIS

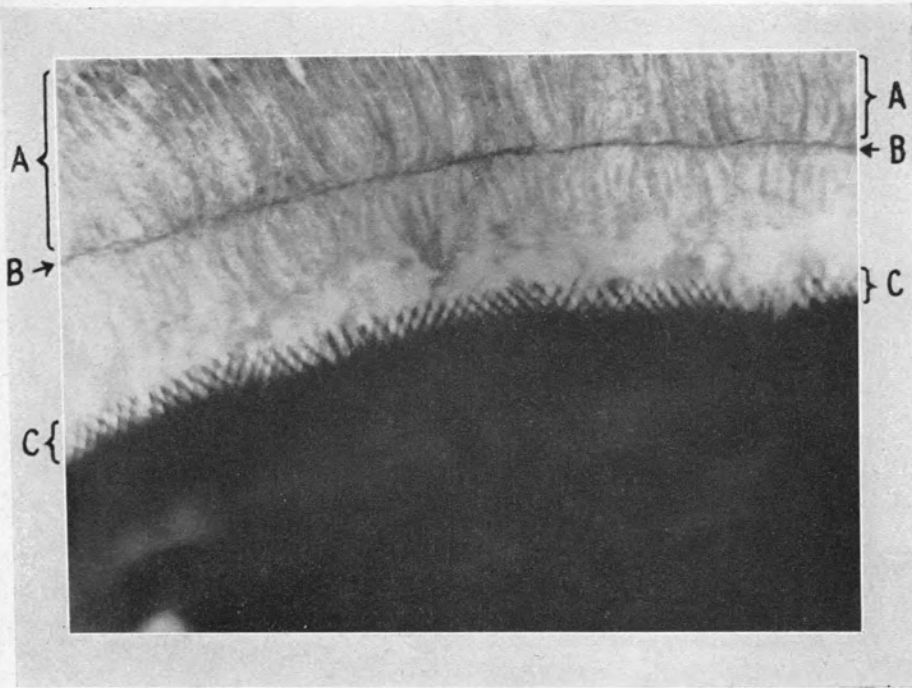


FIG. 11. FIRST MOLAR, 6 DAY RAT, CORONAL SECTION, DECALCIFIED, MALLORY-AZAN
 $\times 1200$.

A. AMELOBLASTS.

B. DAMAGED PRE-ENAMEL PROCESSES APPEARING AS TERMINAL BAR APPARATUS
OR MEMBRANA SECUNDA.

C. LATTICE-LIKE ARRANGEMENT OF HYALINE RODS.

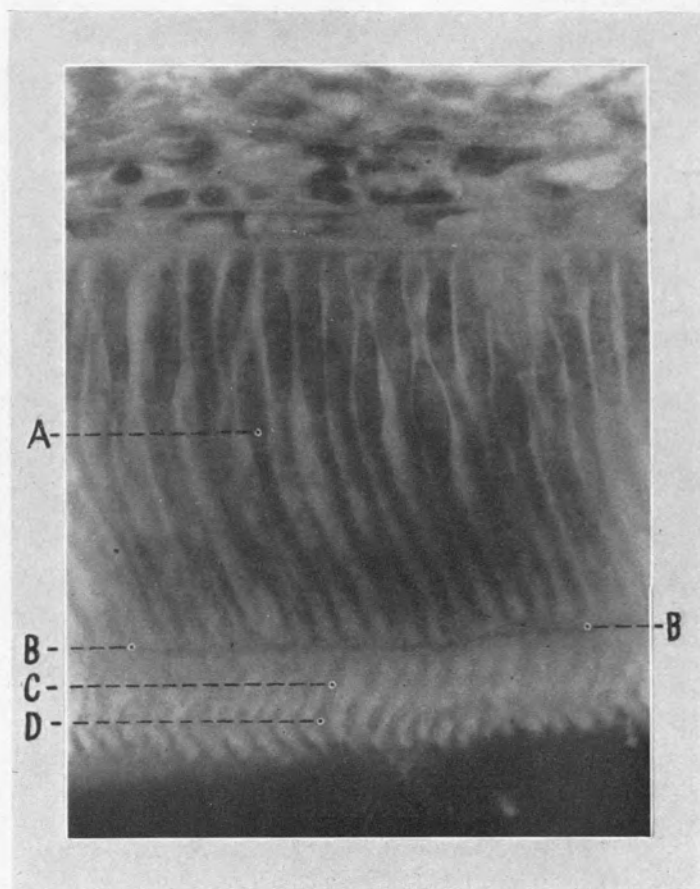


FIG. 12. FIRST MOLAR, 6 DAY RAT, CORONAL SECTION, DECALCIFIED (SECONDARILY), MALLORY-AZAN $\times 1200$.

- A. AMELOBLAST.
- B. RUPTURED PRE-ENAMEL PROCESSES OR SO-CALLED TERMINAL BAR APPARATUS
APPEARING IN LINEAR FORM.
- C. TOMES' PROCESS.
- D. HYALINISED CYLINDER.

AMELOGENESIS

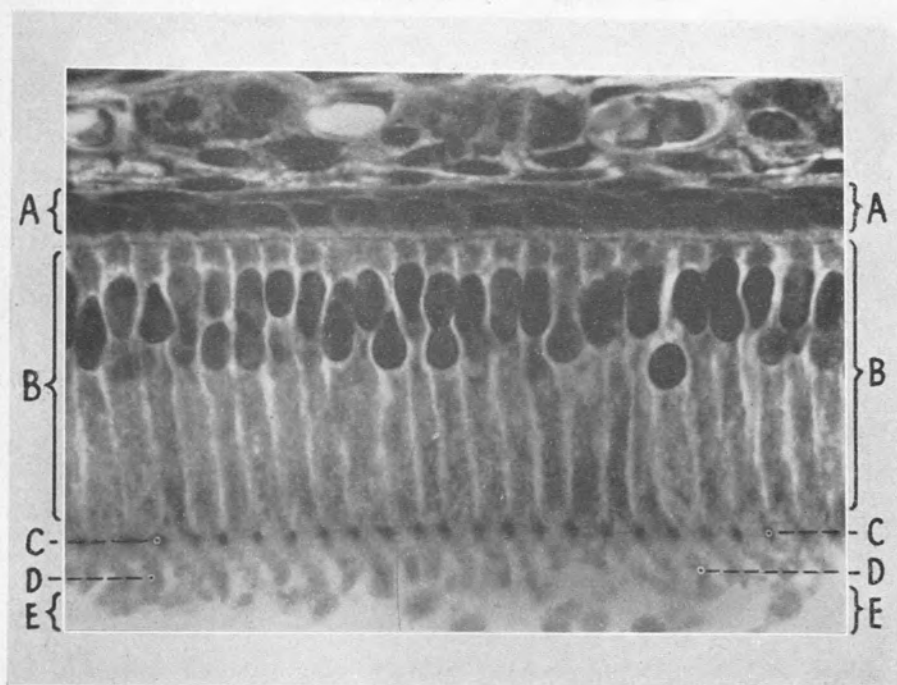


FIG. 13. FIRST MOLAR, 9 DAY RAT, CORONAL SECTION, DECALCIFIED, MALLORY-AZAN $\times 2000$.

- A. STRATUM INTERMEDIUM.
- B. AMELOBLASTS.
- C. RUPTURED PRE-ENAMEL PROCESSES OR SO-CALLED TERMINAL BAR APPARATUS.
NOTE POSITION OF THE DOTS OCCURRING BETWEEN THE CELL.
- D. TOMES' PROCESSES.
- E. REMNANTS OF DISSOLVED ENAMEL MATRIX.

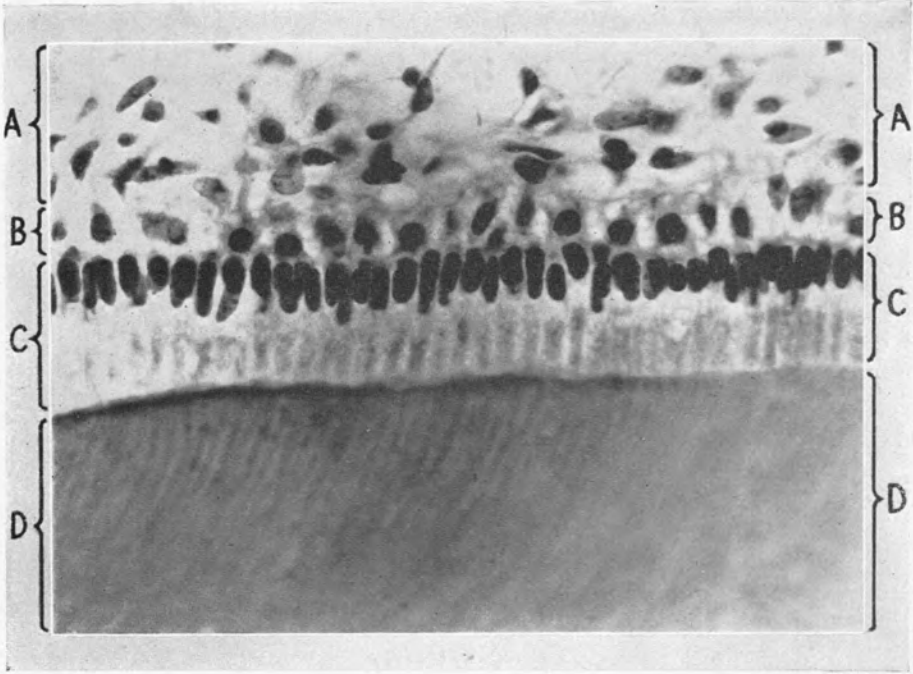


FIG. 14. FIRST MOLAR, 10 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MASSON'S
X2000.

- A. STELLATE RETICULUM.
- B. STRATUM INTERMEDIUM.
- C. REDUCED AMELOBLASTS.
- D. ENAMEL MATRIX SHOWING STRUCTURES—CELL MEMBRANES CAN BE TRACED
THROUGH ITS ENTIRE EXTENT.

AMELOGENESIS

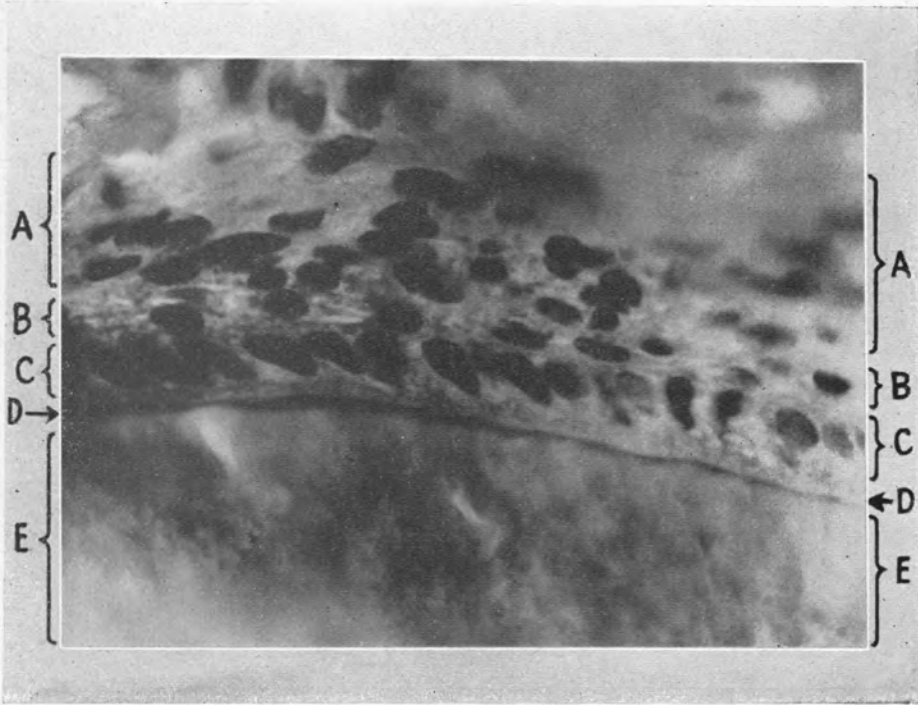


FIG. 15. FIRST MOLAR, 10 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MASSON'S $\times 2000$. FINAL STAGE OF REDUCTION OF THE AMELOBLAST SHOWING HYALINISATION EXTENDING THROUGHOUT CELL.

- A. STELLATE RETICULUM.
- B. STRATUM INTERMEDIUM.
- C. REDUCED HYALINISED AMELOBLAST.
- D. COMMENCING FORMATION ENAMEL CUTICLE (NASMYTH'S MEMBRANE).
- E. COMPLETED ENAMEL.

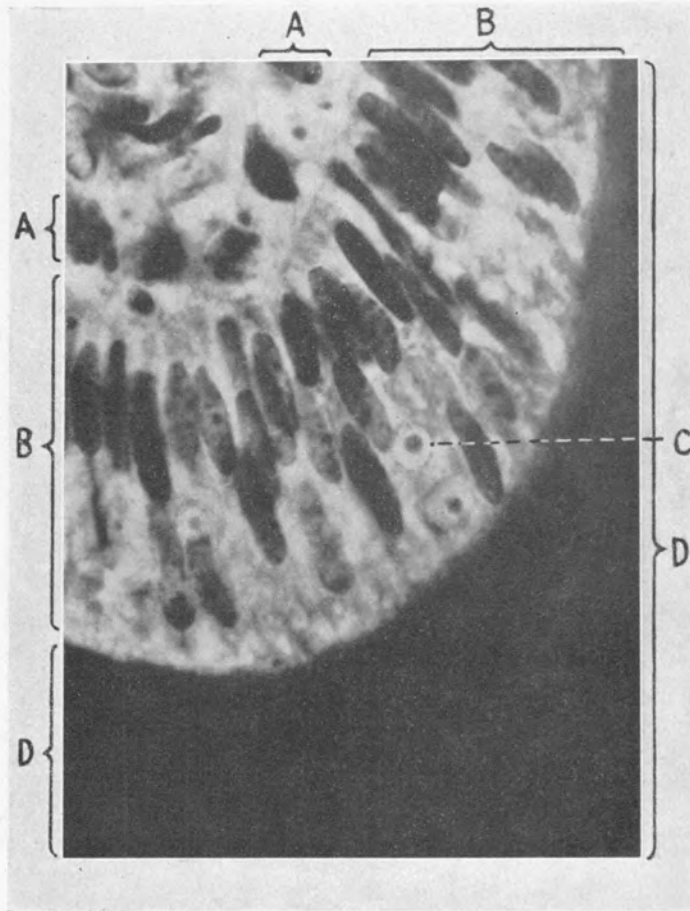


FIG. 16. FIRST MOLAR, 10 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MASSON'S $\times 2800$ SECTION OF INTERCUSPAL SULCUS SHOWING REDUCTION OF AMELOBLASTS AND FORMATION OF HYALINE GLOBULES.

- A. STRATUM INTERMEDIUM.
- B. AMELOBLASTS.
- C. HYALINE OR ELEIDIN GLOBULES ("CALCOSPHERITES").
- D. CALCIFYING ENAMEL.

AMELOGENESIS

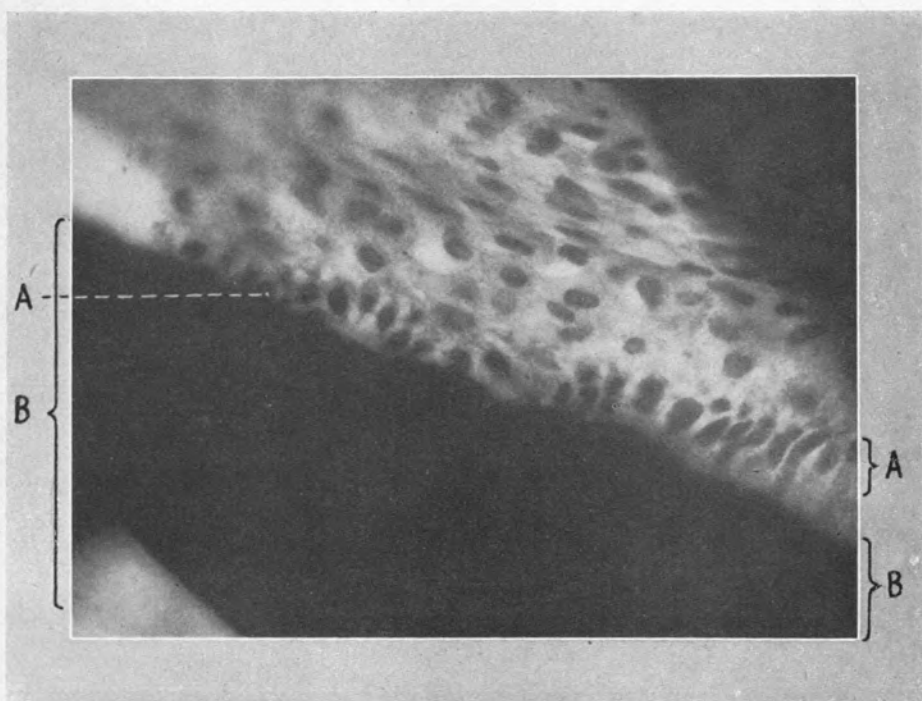


FIG. 17. FIRST MOLAR, 10 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 1200$ ILLUSTRATING THE INCORPORATION OF THE CELL NUCLEUS INTO THE FINAL HYALINISED LAYER OF THE ENAMEL.

- A. PYKNOTIC NUCLEI OF AMELOBLAST.
- B. COMPLETED ENAMEL.

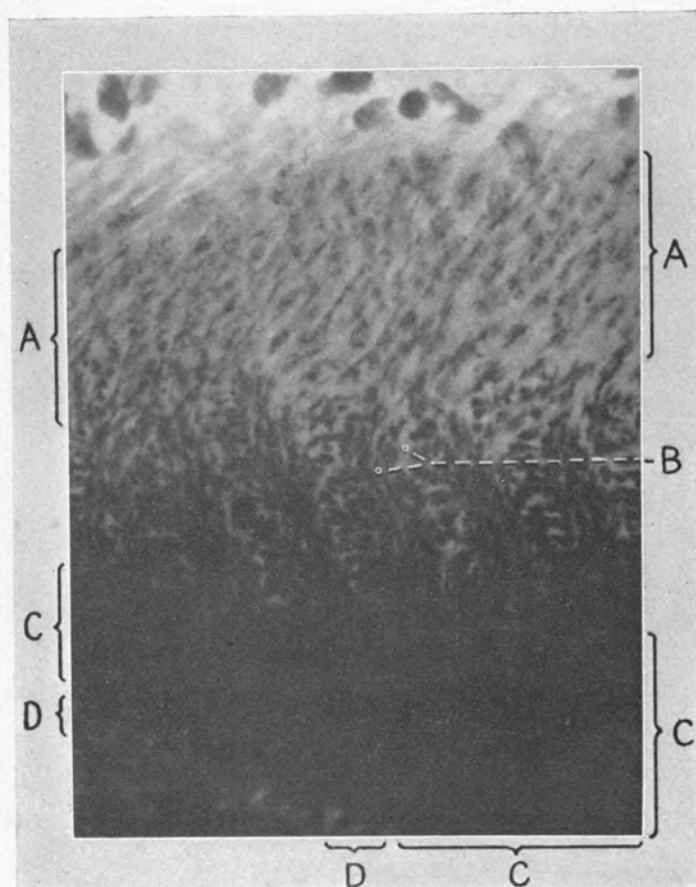


FIG. 18. FIRST MOLAR, 9 DAY RAT, CORONAL SECTION, UNDECALCIFIED MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 1100$.

- A. PARTIALLY CALCIFIED PERIPHERAL ENAMEL.
- B. SCHREGER'S LINES PRODUCED BY VARYING DIRECTION OF CALCIFIED RODS.
- C. FULLY CALCIFIED ENAMEL.
- D. DENTINO-ENAMEL JUNCTION.

AMELOGENESIS

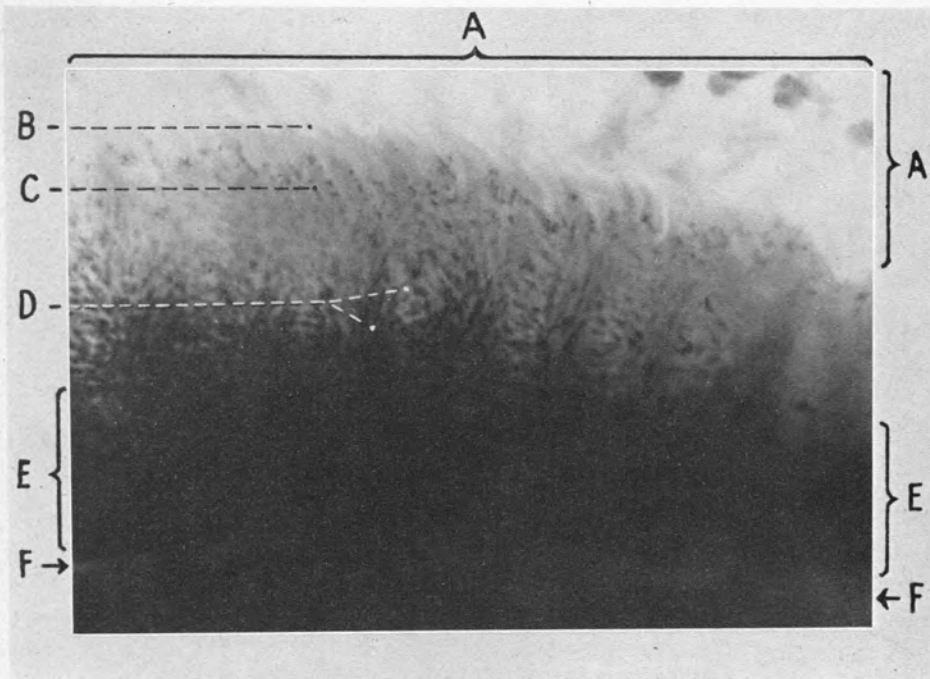


FIG. 19. FIRST MOLAR, 9 DAY RAT, CORONAL SECTION, UNDECALCIFIED, MODIFIED VON KOSSA'S SILVER NITRATE COUNTERSTAINED HEMATOXYLIN AND EOSIN $\times 600$.

- A. AMELOBLASTS.
- B. PRE-ENAMEL PROCESSES.
- C. PARTIALLY CALCIFIED ENAMEL.
- D. SCHREGER'S LINES PRODUCED BY VARYING DIRECTION OF CALCIFYING RODS.
- E. FULLY CALCIFIED ENAMEL.
- F. DENTINO-ENAMEL JUNCTION.

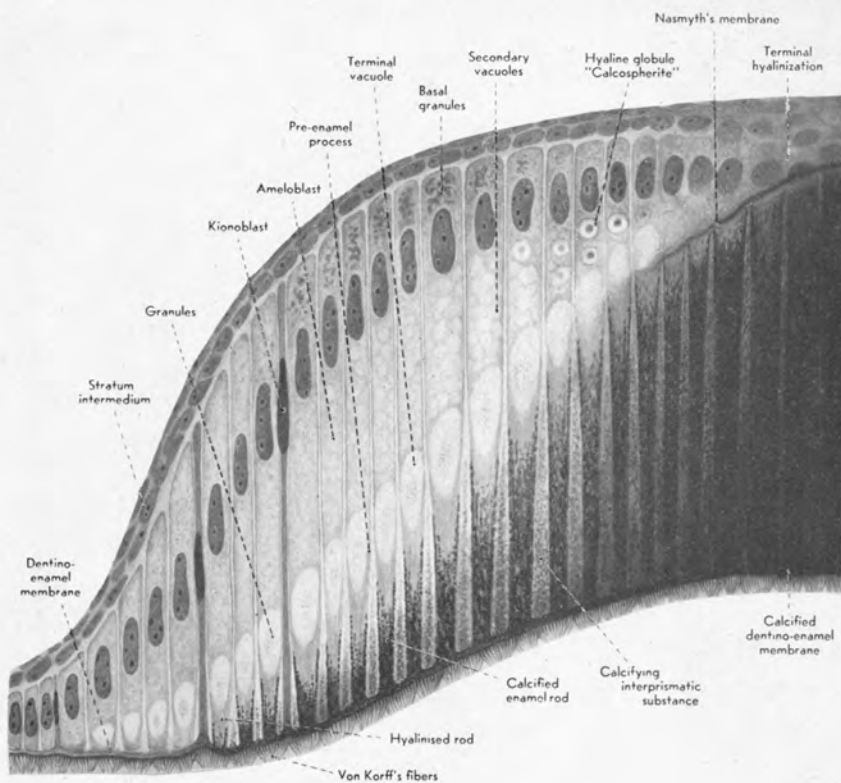


FIG. 20. SCHEMATIC DRAWING ILLUSTRATING PROGRESSIVELY THE DEVELOPMENT AND REDUCTION OF THE AMELOBLAST. THE FIGURE INCLUDES ALL OF THE PHASES WE HAVE OBSERVED CONCERNED WITH THE FUNCTION OF THE CELL, ITS HYALINISATION, THE FORMATION OF THE ENAMEL MATRIX AND ITS CALCIFICATION.

AMERICAN COLLEGE OF DENTISTS
THE COST OF ADEQUATE DENTAL CARE FOR ADULTS¹

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I. INTRODUCTION

It is my purpose today to give you a brief report of the major findings of the Socio-Economics Committee in its analysis of the cost of adequate dental care for adults under specific clinic conditions. My presentation in the most part will be a digest of the detailed report of this project now in the hands of the Regents.⁴ I shall begin by telling you something of the developments which led us to undertake the project.

2. DEVELOPMENTS LEADING TO THE INITIATION
OF THE PROJECT

In the attempt to think through the implications for the dental profession of some of the rapid changes taking place in our complex social order, certain men in dentistry gradually came to recognize that the profession lacked the factual data necessary for the

¹A condensed Report of the Findings of the Dental Health Service Project. This was delivered as an address at the Convocation, Houston, Texas, Oct. 26, 1941.

²The other members of this Committee are (1940-41): E. H. Bruening, W. H. Mork, B. B. Palmer, M. W. Prince, K. C. Pruden, Maurice William, G. W. Wilson.

³Grateful acknowledgement is made to Mrs. Dorothy Fahs Beck for her invaluable assistance in this report.

⁴For the factual basis of statements made in this paper, see the complete report entitled: *The Cost of Adequate Dental Care for Adults under Specific Clinic Conditions: An Exploration of General Issues on the Basis of the Initial and Maintenance Care Experience of 485 Patients of Dental Health Service, Inc., New York City.* (Not yet published.)

type of objective self-analysis that was needed. In view of the importance to the profession of a satisfactory social and economic orientation, it seemed imperative that these data be obtained. So many angles from which such an analysis might be approached were suggested, however, that the question was where to begin.

Some years ago the American College of Dentists began building the background for meeting developments in our own country by making a study of European medical and dental dispensary plans. The report, produced by the researches of Simon and Sinai, and known as "The Way of Health Insurance," has taken its place as a very important contribution to thought and planning along these lines. It has been widely read by medical and public leaders, as well as by dentists, and has also been in demand in a great many foreign countries where similar problems must be faced. The former Chairman of the A. D. A. Committee on the Study of Dental Practice, Dr. Herbert E. Phillips of Chicago, directed this study.

Some time after the completion of this project, a Committee on Socio-Economics was established as a permanent committee of the College. Its early efforts were devoted chiefly to a study of the various proposals for new forms of dental dispensaries and to the formulation of opinions as to the principles that should govern such readjustments. In addition, close scrutiny was given to the opinion, so freely expressed by many, that clinics provided the answer to the question of high costs and accessibility of dental services. Obviously the only way to get the facts on most of these controversial issues was to make the necessary studies.

In the course of these discussions, it was suggested to the Chairman of the Socio-Economics Committee of the American College of Dentists that the Dental Health Service Clinic of New York City would be the type from which much valuable material could be obtained. It was recognized that the study of no single clinic could provide the answer to the question of whether clinics offered the cheapest form for the distribution of dental care. Nevertheless, the nonprofit pay clinic did appear to offer favorable conditions for the study of the cost of adequate care for adults under controlled conditions. Among these favorable conditions was the fact

that the records of the clinic contained both the detailed facts needed regarding time and cost by specific service categories and notations that would permit the separation of initial care from maintenance care. It was likewise helpful that the clinic was serving the type of clientele for whom health insurance and similar proposals are often made. Much weight also was given to the fact that the standard of service was considered reasonably adequate by the governing body made up chiefly of well-known and reputable dentists of the City of New York. Because all these and other conditions appeared conducive to a significant study, the Regents of the College authorized and directed the Socio-Economics Committee to proceed with an analysis of the cost of care for selected adult patients of this clinic. This study has extended over a period of approximately two years.

3. THE NEED FOR THE STUDY IN RELATION TO RECENT DEVELOPMENTS

Throughout, our primary purpose has been to provide data that would be useful to public and professional leaders attempting to predict costs and personnel needs in connection with various types of proposals for the extension of dental care. To appreciate the need for data on the cost of adequate care for use in connection with social planning, one must be familiar with recent trends in the financing and distribution of the health services. A few of these major developments will therefore be mentioned.

Some forms of public dental care have been with us for many decades. The depression of the thirties, however, has stimulated an unexpectedly rapid expansion in dental care programs financed with public funds. Sooner or later the administrators of practically every type of federal relief program have come to the realization that some provision had to be made for meeting urgent dental needs along with those for food, clothing, shelter, and other health services. Neither the total number of recipients of dental care on these varied programs, nor the total amount being spent for public funds for meeting dental needs can be stated in definite figures. A review of the programs involved indicates, nevertheless, that

those eligible for some amount of dental care from public funds number many millions and that expenditures for such care likewise total in the millions of dollars yearly.

Even though these sums may seem large in total, they necessarily must be spread very thin in order to reach all those eligible. As a result, the level of care provided is inevitably very meager. In the main the services provided consist of emergency extractions and fillings, occasional denture work when needed for employment or health purposes, prophylaxes and fillings for children, and dental health education. Occasionally, service extends into other categories. For example, in the program of services for crippled children that is receiving federal aid through the United States Children's Bureau, provision is made for orthodontia services for harelip and cleft palate cases. Other types of malocclusion, however, are not yet considered to fall within the Children's Bureau definition of a crippling condition, even though such defects may be fully as crippling to a child's future as a harelip or a cleft palate. Only a small change in this interpretation of what constitutes crippling would be needed to open up an entirely new and potentially very large field for federal aid for dental care for children.

This possibility is merely one of many that might be mentioned to illustrate the directions in which public dental care may ultimately expand. Experience with the present emergency type of public dental care is creating at many points a demand for a more adequate and inclusive type of care and for the extension of benefits to other groups. In view of these trends, it is easy to appreciate why it is important to have at hand information as to what an adequate level of care will cost and how much personnel will be required.

The need for information as to costs arises also from another source. Legislators likewise have been active in devising and promoting proposals for public medical care and for health insurance. A few facts will illustrate pressures in this direction. The reports of the Legislative Committee of the American Dental Association indicate that during the last three years there have been a total of

at least 166 bills relating to health insurance, public medical care or related issues introduced in the state legislatures of this country. Of these, twenty-seven have proposed compulsory health insurance. No similar count has been made of federal bills, but one can be sure that the number would be surprisingly large. Some of these bills omit dentistry entirely and others propose that dental care be limited to such an inadequate level as to be highly unsatisfactory both to the patient and to the profession. It is obvious that if the profession is to urge effectively a more adequate level of care in connection with such legislation, it must be in a position to state approximately what such care will cost and whether there are enough dentists to provide it.

The war is turning the attention of the public to still another aspect of the total dental health problem. The wide publicity given to the deplorable dental conditions being found among the draftees has dramatized for the public as little else could, the importance of dental health. From many sources has come endorsement of the suggestion that dental rehabilitation service be provided from public funds to selectees rejected for dental reasons. In line with these suggestions President Roosevelt launched a program of rehabilitation for rejected draftees. The medical and dental work needed is to be done by local physicians and dentists and is to be paid for from federal funds. It is expected that some 200,000 men can thus be made available for military service. Since dental conditions constitute the largest single cause of rejection and since these defects can be corrected by treatment in more than the usual proportion of cases, dental care probably will play a large part in these rehabilitation efforts. Planning for this program again will involve cost estimates, though in this case those needed will be of the initial type.

These comments by no means provide a complete picture of the possible uses of the data for social planning. In addition, numerous smaller scale proposals continually make their appearance, such as medical and dental society plans, industrial dental programs, fraternal society plans, pay and part-pay clinic projects, city-wide plans for children's work, and the like, all of which involve some degree

of experimentation with new technics for the extension of dental care to groups now inadequately provided for.

To supply the needed information on costs, there have been available hitherto only statistics on initial care. These have been the result of a variety of studies of initial costs and service needs, among which are the Swanish report, Dr. Brandhorst's study in Missouri and Southern Illinois, several New York City clinic studies, and the recent American Dental Association survey. While these have all added to our total fund of information, they have in each case dealt primarily with cases of the initial type for whom a period of neglect preceded the examination analyzed. Consequently, the averages reported are very large. When these are multiplied by the number in the population at the low income levels, the results reach astronomical proportions.

Fortunately, however, the cost problem is not so acute as such estimates would lead one to believe. Initial care can be provided slowly and to a small fraction of the population at one time. In fact, the normal rate of expansion in demand automatically would provide for the spreading out of the initial burden over a considerable period. Moreover, for the next generation, a large initial bill can be avoided entirely by early and regular care throughout childhood. Long continuing programs must be expected to be essentially maintenance programs. As such, they should prove much less expensive than these initial care figures would indicate. How much less expensive they would be we have not hitherto known. We have had only estimates to go by and these have had to be made with little factual foundation. They have not been sufficiently accurate to provide a safe guide for predicting costs. It is at this point that we hope that the most basic contribution of this study will be made.

4. OTHER INDIRECT VALUES OF THE STUDY

While the detailed statistics of the study are designed primarily for leaders in social planning, there are two other groups who should find the report of considerable interest. For example, it should help all of us, lay and professional, to decide for ourselves what types of programs seem feasible and reasonable from the point

of view of cost and personnel requirements, and which are impractical or promise more than they can deliver. In addition, we as private practitioners can find a great deal of interest and value in the picture that is provided of many of the aspects of a normal dental practice. The possible uses of the data in these two connections will become clear as the data themselves are presented and their implications are discussed.

5. DISCUSSION OF THE REPORT

The analysis itself has been focused on two major questions: (1) What is the cost and what time is required to furnish adequate initial and maintenance care to a given group of adults under one set of known conditions? and (2) What are the basic principles that govern variations in costs from group to group? In other words, we have endeavored to find not only averages for a given group, but so to analyze the factors affecting time and costs for this group that others can predict costs under conditions and for groups of patients quite different from those actually studied. How we have done this will be evident to some extent from some of the charts that have been prepared.

The nonstatistical phases of the study have included a review of current trends in the financing and distribution of the health services, a review of all other research pertinent to the problem, and a comparison of the findings with those of other studies, including medical economic studies and consumer surveys.

A. *Types of patients studied.* In considering the findings it is important that one have in mind a general picture of the types of patients whom we studied. The group was limited to adults, of whom we were able to find four hundred and eighty-five who met our requirements as to regularity and adequacy of care. All of these had met the income requirements for admission to Dental Health Service and consequently may be assumed to have been unable to pay for adequate care at prevailing private fees in New York City. Except for a few cases paid for by welfare agencies, the lowest income group who utilize free clinics also was excluded automatically by the customary fees charged by the clinic. The average

family income of the group studied may be thought of as a little over \$1,000 per year. Since we desired to learn the cost of care that could be termed reasonably adequate, we required in addition that every one who was accepted should have completed initial care and a period of relatively regular maintenance care, and that they had met a reasonably adequate though economical standard of care throughout. The type of care that these patients received may be visualized as adequate in quantity and quality but as consisting primarily of preventive and diagnostic services, plastic fillings, full and partial vulcanite dentures, palatal and lingual bars, and a variety of supplementary services as needed. Gold inlays, crowns, fixed and removable bridgework, and the more expensive denture materials were limited to a minimum. Minor exceptions also were made in the requirement as to completeness of care, particularly with respect to prophylaxis and x-ray, since some concessions were necessary in order to secure a sample of sufficient size. Whenever care was incomplete in these respects, estimates were added to indicate the additional care recommended. Thus our findings leave unsolved the question of how much care any given group will make use of under any given set of circumstances—or, in other words, that old familiar problem of demand. This problem is one that must await other research efforts and experimentation on actual projects.

A further question of importance is whether by this selection process we secured a group of cases who in other respects are not typical patients. If they are not, one might wonder whether they were worth studying at all. We have been aware of this problem and have made a number of statistical comparisons in order to secure an answer. It is our conclusion that while our patients are somewhat different from a normal cross section of the total population, they follow a pattern in regard to age, sex and occupation, that is approximately similar to that for persons everywhere who seek dental care. In respect to dental needs, we find that they take a middle position between the very low tooth loss characteristic of the professional classes who have had more or less continuous dental care, and the very high tooth loss characteristic of the lowest income

groups who have had only occasional dental care. Thus one can think of them as typical of dental patients who have had the benefit of a moderate amount of previous care.

B. *Financial characteristics of the clinic studied.* Before considering the actual findings, you will want to know also something of the financial side of Dental Health Service. The adult fees at this clinic you may visualize as very similar in most items to welfare fee scales throughout the country. For x-ray services and dentures, the clinic fees are probably a little below typical fee scales of the welfare type. The actual cost to the clinic of providing the service averages about \$4.50 per hour for the time of the dentist and \$2.25 per hour for the time of the hygienist or x-ray technician. These figures include administration and fixed operating expense, but exclude laboratory charges. The exact figures vary, of course, from year to year. The dentists on the staff are paid somewhat more than \$2.00 per hour on duty. Their rate of pay may be thought of as approximately equivalent to \$4,300 annually on a full-time basis, or about the same as the average net income of dentists in 1929. As a result of these fees and this salary scale, the clinic typically incurs a small deficit, most of which can be attributed to the policy of granting reduced fees for children's work.

With this introduction to the clinic and the patients whom we studied, we shall now turn to an examination of a group of charts that will serve to give you a quick visual survey of our major findings.⁴ The details of the statistics, the qualifications that are applicable to them, and the sources used in their interpretation, all will be available in full in the report itself.

C. *Findings with respect to the general averages for time and cost.* The first of these charts presents a picture of the proportion of patients incurring bills of various amounts for the care that they actually received. Two lines are shown, one for initial care and one for annual maintenance care. From the striking differences between these two lines, the importance of retaining at all times this distinction as to type of care becomes abundantly clear. The initial bills

⁴The charts included were presented as lantern slides in the talk delivered at the Houston Convocation; these slides are available on request for use by others.

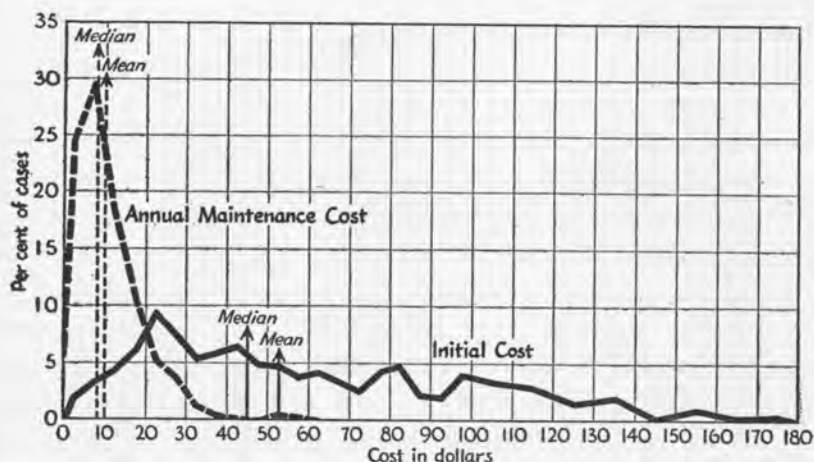


CHART 1. PERCENTAGE DISTRIBUTION OF CASES ACCORDING TO THE COST TO PATIENT OF INITIAL AND ANNUAL MAINTENANCE CARE ACTUALLY RECEIVED.

for these patients extended all the way from less than \$10 to about \$180, with a heavy concentration of cases between \$15 and \$60. A substantial number of persons were found with initial bills above \$100. These relatively high costs at the beginning of the period of care at the clinic were the result of a long accumulation of neglected needs and were not typical of later care. For all these patients considered together the average initial bill for services actually received was \$52.66, while 50 per cent of the patients incurred bills of \$45 or less.

In contrast to initial care, relatively few of the patients incurred average annual maintenance bills of over \$20 a year and figures under \$10 were most frequent. The figures shown represent averages over a period of years, covering in the majority of cases at least a three-year span. In spite of the leveling effect of this procedure, however, substantial differences between patients still were found. The average patient received maintenance care that cost him an average of \$10.05 per year, while 50 per cent of the cases paid \$8.30 or less for the care that they actually received.

Chart 2 adds further information with regard to the general level of the averages by presenting them on a variety of bases. The

middle bar in the upper section of the chart represents, for example, the cost to the patient of the initial services that he required when his bill was calculated in terms of the usual adult fees at the clinic. The crosshatched portion of this bar indicates the average cost of the work that the patients actually secured, and the dotted extension, the amount that would have been added to this cost if every patient had followed the recommended procedure of a full-mouth

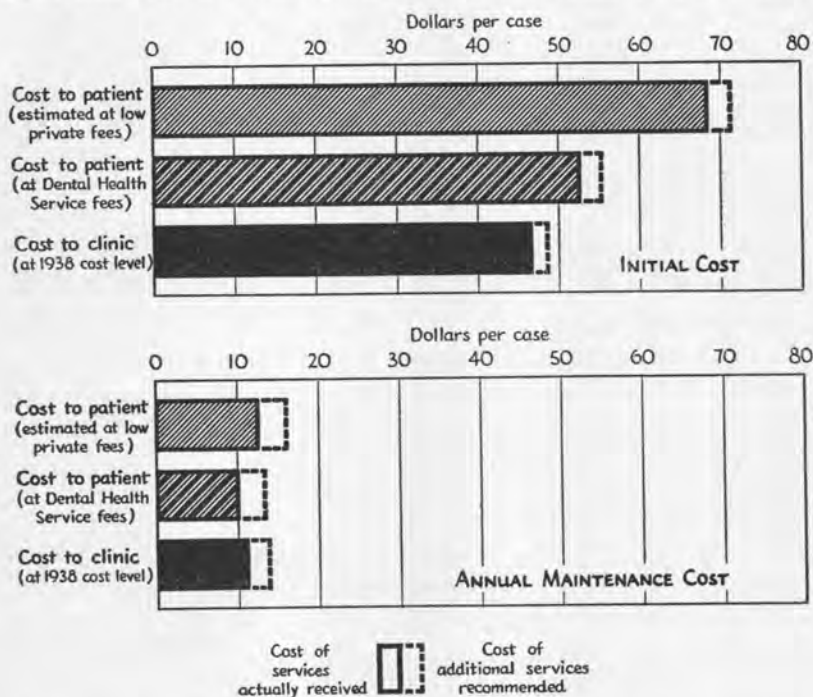


CHART 2. AVERAGE COST TO PATIENT AND AVERAGE COST TO CLINIC OF INITIAL AND ANNUAL MAINTENANCE CARE.

x-ray series every two years and a prophylaxis twice a year. The actual bills calculated in this manner averaged \$52.66 for services actually received and \$55.23 for all services needed. The third bar shown in black represents the estimated cost to the clinic of providing these initial services. These estimates were based on (1) the general clinic cost experience converted to a per-hour basis and (2) the time required by these particular patients for the work that

they secured. In actual values the cost to the clinic of serving the average patient was \$46.60 for the initial services actually provided by the clinic, or \$48.65 for all services that were recommended. Thus the surplus of fees above the actual cost of the work was about \$6 per patient on the average. The top bar represents still another type of average, namely, that computed on the basis of the estimated cost to the patients of these same services if they had paid for them at typical low, urban, private fees instead of at the fees charged by Dental Health Service. When estimated on this basis, the initial bills of these patients amounted to \$68.34 for services actually received, or \$71.34 for all recommended services. These estimates are, of course, approximate only. Nevertheless, in comparison with the averages found in other studies, they take a conservative, middle position and seem, moreover, to be entirely reasonable. Their major significance lies in the fact that regardless of the method used in computing the cost, initial dental care clearly requires a very substantial expenditure if one thinks in terms of what either the low-income patient can pay for his own care or what the government or others can afford to pay in behalf of large numbers of such persons. The size of this initial bill is obviously the result of long neglect.

The three lower bars in Chart 2 indicate how much less the costs amounted to on these same three bases after initial care had been completed and only current maintenance needs had to be met each year. Again the bar representing the private fee estimate is the longest of the three, but this time the difference is much less conspicuous than in the case of initial care. Another difference is also apparent, namely, the fact that the bar for cost to the patient at clinic fees is slightly shorter than that for cost to the clinic. In other words, the clinic fees charged for maintenance work in general were not sufficient to cover the cost of the service given. The loss to the clinic amounted to about \$1 per patient per year. The actual averages for the annual cost to the clinic was \$11.14 for services actually provided, while the corresponding charges to the patients averaged \$10.05. All recommended services would have cost the clinic \$13.87

per year to provide, but would have cost the patients an average of only \$13.26 if paid for at standard clinic fees. If the patients had paid the low private fees assumed in the case of the corresponding initial care estimates, the services actually received would have cost them an average of \$12.62 annually, while all recommended services would have totaled \$16.05. All these maintenance figures are

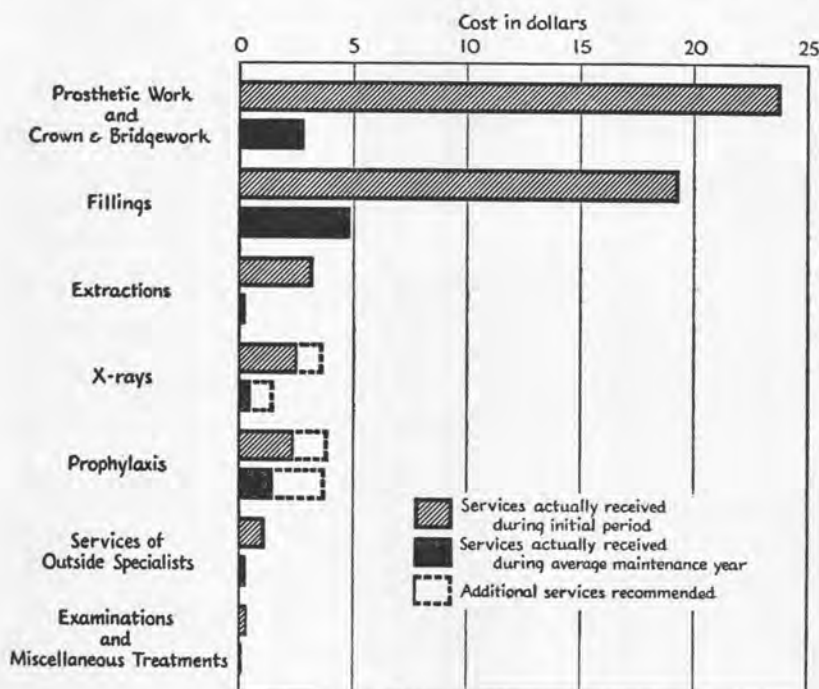


CHART 3. AVERAGE COST TO PATIENT OF VARIOUS TYPES OF SERVICE DURING THE INITIAL PERIOD AND DURING AN AVERAGE MAINTENANCE YEAR.

somewhat higher than previous estimates of maintenance costs had led us to anticipate.

D. *Findings regarding individual types of service.* Chart 3 introduces important detail as to the various components that make up the total cost figures already cited. The two largest segments obviously are that for prosthetic work and crown and bridgework and that for fillings. Prosthetic work and crown and bridgework, which at Dental

Health Service are confined primarily to the provision and maintenance of full and partial dentures, accounted for \$23.78 of the total initial bill to the patient. Fillings, primarily plastics, added \$19.37, and extractions, \$3.20. No other initial service actually received by these patients cost them more than \$3 on the average, although prophylaxis and x-rays would have exceeded this figure if all the services recommended had actually been received throughout the initial period.

These averages can be contrasted readily in Chart 3 with the corresponding maintenance care figures shown in the adjacent black bars. On the maintenance care basis, prosthetic work and crown and bridgework cost these patients only \$2.76 per year; fillings, only \$4.80; and extractions only 20 cents. The greatest savings from maintenance care clearly were achieved in services classified in the extraction and prosthetic service groups, and the least, in the diagnostic and preventive service categories. The very low need for extractions under maintenance conditions was found to be particularly striking and illustrates vividly the saving in teeth that adequate maintenance care makes possible.

Approaching the same findings from another point of view, Chart 4 presents these averages for individual types of service as components of bars whose total length represents in each case the total for all services combined. The two upper bars are charted in terms of dollars, and the two lower ones in terms of hours. Again, from the point of view of cost, prosthetic work and crown and bridgework and fillings constitute the largest components of both initial and maintenance care. Services involving replacements do not contribute as much to the totals for time, however, as to those for cost, partly because the time figures include only chair-time and thus omit time spent in laboratory work. Fillings, which are always time consuming, naturally loom large both in the time totals and in those for cost. They are also important both during initial care and during maintenance. In contrast to fillings, however, extractions under maintenance conditions form such small segments that they are almost invisible in the chart.

Since the general time averages have not appeared in previous charts, the actual time averages will also be cited at this point. Initial care required 8.5 hours of chair-time per patient for the services actually received, and maintenance care, about 2.4 hours annually. If all the prophylaxes and full-mouth x-rays recommended actually had

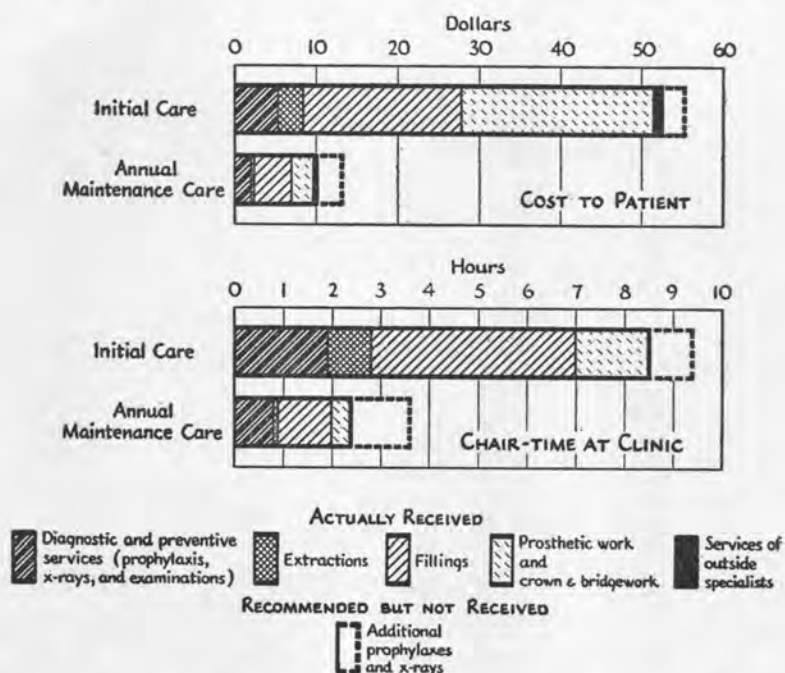


CHART 4. AVERAGE COST TO PATIENT AND AVERAGE CHAIR-TIME AT CLINIC REQUIRED FOR INITIAL AND ANNUAL MAINTENANCE CARE, BY TYPE OF SERVICE.

been received, the two figures would have been raised to 9.4 hours and 3.6 hours, respectively. These figures exclude laboratory time and the time of specialists since time records were not available for either of these types of functions. Nevertheless, even with these omissions, these averages appear very substantial when they are visualized in terms of the total needs of persons in the population who are not now receiving dental care in adequate amounts. They also are high in relation to the usual time required for the provision of general medical services.

The next illustration, Chart 5, helps to place these averages in a wider perspective by comparing the amount of service of various types received by these Dental Health Service patients during an average maintenance year with the amounts of similar services received annually by average adults in the general population. The

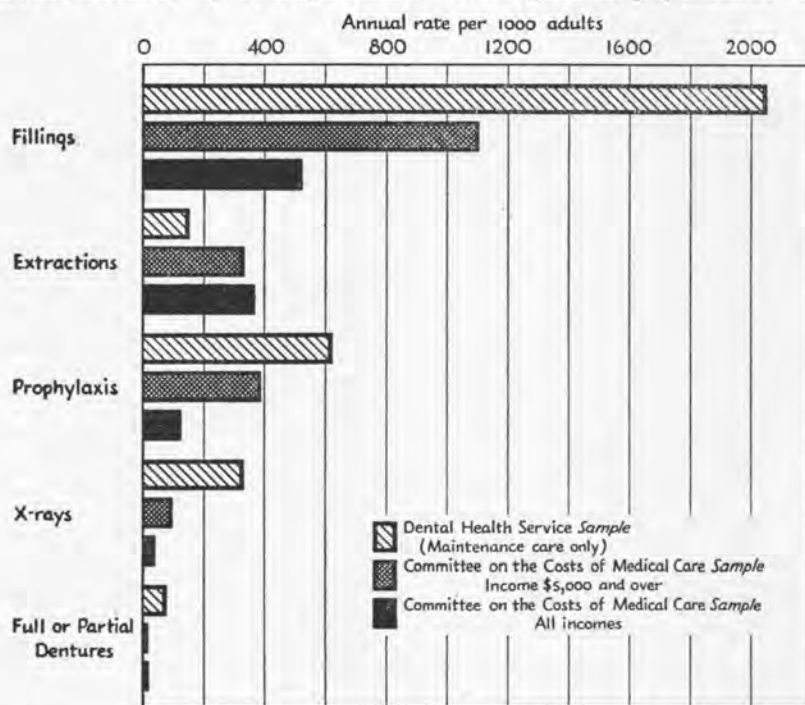


CHART 5. ANNUAL FREQUENCY OF CERTAIN DENTAL SERVICES DURING MAINTENANCE CARE AMONG PATIENTS IN THE DENTAL HEALTH SERVICE SAMPLE AND UNDER AVERAGE CONDITIONS AMONG PERSONS IN THE SAMPLE STUDIED BY THE COMMITTEE ON COSTS OF MEDICAL CARE.⁵

figures for the population at large were collected by the Committee on the Costs of Medical Care. The lightly shaded bars represent the Dental Health Service patients; the heavily crosshatched bars, those adults in the general population having family incomes above \$5,000 per year; and the solid black bars, the population at large irrespective of income. By comparing these bars one may conclude without hesitation that even under minimum care conditions, such as prevail during maintenance care, these Dental Health Service

⁵Medical Care for the American People: University of Chicago Press, 1932.

patients were receiving vastly more care of most types than was being purchased even by those in the general population with family incomes of over \$5,000 per year. The contrasts are even more marked when comparisons are made with the population as a whole. The only exception to this pattern is found in the case of extractions. In this instance Dental Health Service patients who received regular and adequate care were found to need less than half as many extractions per year as were needed by even the relatively wealthy group in the general population. This good record was maintained in spite of the fact that the Dental Health Service patients secured all the extractions that they needed, whereas those in the general population probably did not. The conclusion seems unescapable that even this comparatively well-to-do group is not securing care that approaches adequacy even for maintenance purposes.

Chart 6 introduces an entirely different type of analysis of the

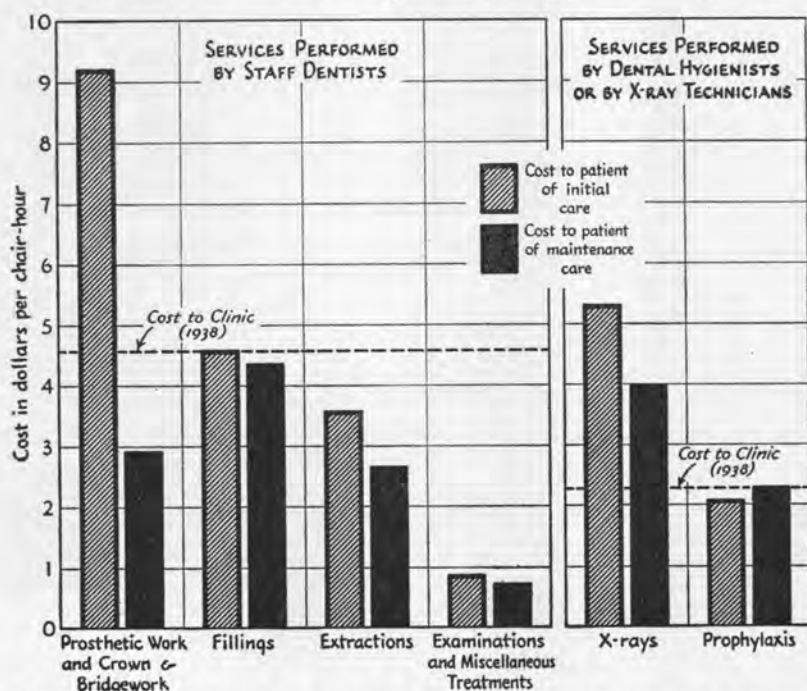


CHART 6. AVERAGE COST TO PATIENT AND AVERAGE COST TO CLINIC PER CHAIR-HOUR, BY TYPE OF SERVICE AND TYPE OF STAFF. (PAYMENTS TO LABORATORIES HAVE BEEN DEDUCTED FROM THE FIGURES FOR COST TO THE PATIENT.)

basic data collected for this study. By an inspection of this chart it is possible to determine which services paid for themselves through the clinic fees charged and which were furnished at fees below the cost of providing the service. The approximate hourly cost to the clinic of any service that required the chair-time of a dentist is represented by a dotted line charted at the level of \$4.57, the actual average cost of an hour of chair-time with a dentist at Dental Health Service in 1938. The cost of an hour of chair-time with a dental hygienist or x-ray technician likewise is represented by a dotted line, in this case charted at the level of \$2.28, again the actual figure for Dental Health Service in 1938. The bars, in turn, represent the hourly charges to the patients minus laboratory charges paid in their behalf by the clinic. A comparison of these bars with the cost levels plotted indicates clearly that the two sources of surplus to the clinic were: (1) initial prosthetic work and crown and bridge-work and (2) x-ray service. Fillings and prophylaxes were performed approximately at cost, and extractions, examinations, miscellaneous treatments, and maintenance services in connection with replacements produced substantial losses. The contrasts between services in this respect were marked. While fees for initial prosthetic work and crown and bridgework averaged a return of about \$9 per hour after laboratory costs were deducted, examinations and miscellaneous treatments brought in only 87 cents per hour of time spent on these functions. Moreover, in all fields, except prophylaxis, maintenance services were the source of less income per hour than were initial services in the same category.

The totals to which these hourly surpluses and losses accumulated in the course of initial and maintenance care for these four hundred and eighty-five patients are illustrated in Chart 7, the losses being shown in the left-hand section and the surpluses, in the right-hand one. During initial care the largest losses were experienced on examinations and miscellaneous treatments, and the largest surpluses, in the prosthetic work and crown and bridgework category—which it will be remembered consisted in this program largely of denture services. During an average maintenance year, x-ray service again

resulted in a slight surplus, though less in amount than during initial care. Prophylaxis service was furnished approximately at cost rather than at a loss as during initial care, while all other services were provided at a loss. The contrast between initial and

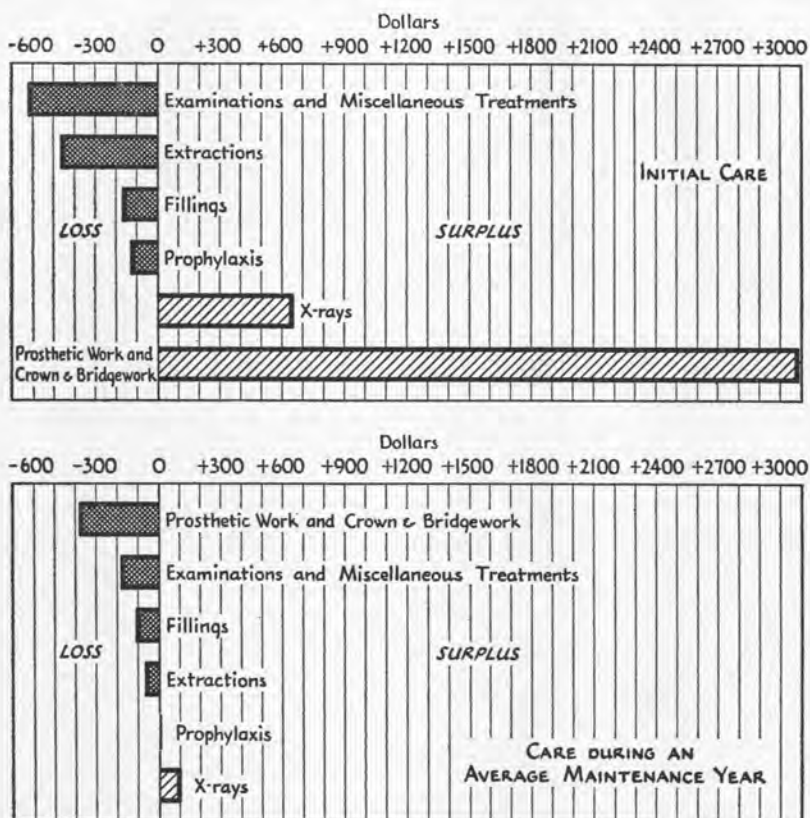


CHART 7. ESTIMATED NET SURPLUS OR LOSS INCURRED BY DENTAL HEALTH SERVICE IN FURNISHING INITIAL AND ANNUAL MAINTENANCE CARE TO THE 485 PATIENTS IN THE SAMPLE, BY TYPE OF SERVICE.

maintenance care is particularly striking in the case of prosthetic work and crown and bridgework. While work in this category was responsible for substantial surpluses during initial care, the losses on this type of work during maintenance care were the largest in any category and amounted in the average year to about \$380 for

these particular patients. This relative ranking, it must be remembered, is dependent upon the use of hygienists. If the prophylaxes had been performed by the dentists, this service rather than service in connection with replacements would have been the source of the greatest loss during maintenance. Under such arrangements the losses on prophylaxes alone would have amounted to about \$1,800 per year of maintenance care for these patients if the usual \$2 fee had pertained and the same amount of time had been used. The significance of this maintenance care analysis lies partially in the ease with which it makes it possible to imagine the depressing effect on dental incomes of a transition to maintenance functions only, such as an adequate lifetime care program implies.

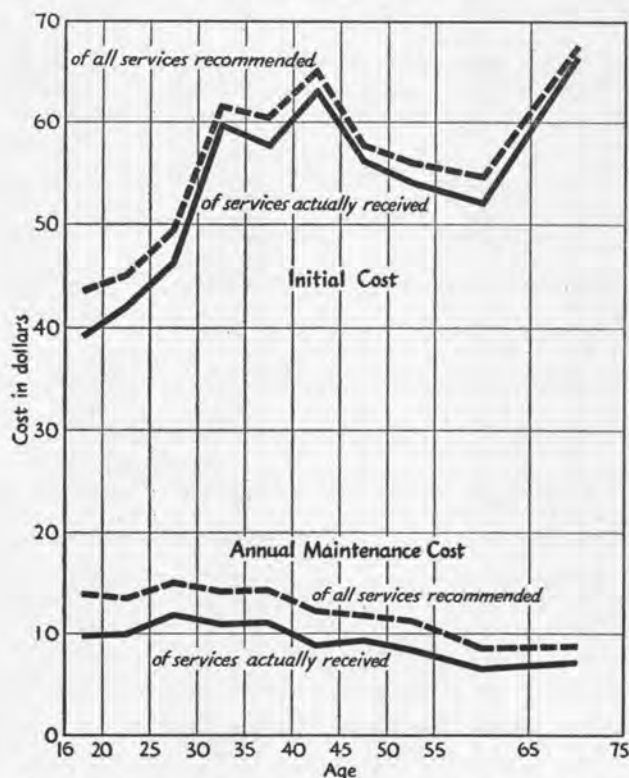


CHART 8. AVERAGE COST TO PATIENT OF ALL SERVICES ACTUALLY RECEIVED AND ALL SERVICES RECOMMENDED DURING INITIAL AND ANNUAL MAINTENANCE CARE, BY AGE.

E. *Findings with reference to age differences.* The next few charts present a graphic picture of the variations in dental needs by age. The first of these illustrations, Chart 8, is confined to the portrayal of total costs by age. The two top lines represent initial costs, and the two bottom lines, annual maintenance costs. The solid lines plot costs for services actually received, while the dotted ones indicate how much these costs would have been increased if the additional prophylaxes recommended actually had been received. The amounts added to the maintenance figures by this estimating process are seen to be greater proportionately than those added to the initial care totals.

When the age trends are examined, it is at once apparent that the cost of meeting the accumulated initial needs was in general higher at the older age levels than at the younger, while maintenance costs were less. The higher initial costs characteristic of the older age levels probably can be attributed in part to the tendency of older persons to visit a dentist less frequently than their younger contemporaries. In addition, among older persons, neglect has usually continued over a longer total period with the result that the total accumulation of work needed is greater. By the time the decade of the forties is reached, major replacements generally are imperative. The reduced initial costs after the early forties probably reflect the fact that these major needs have been met in many cases during the preceding decade.

In contrast to the rather irregular but generally upward lines for initial costs, annual maintenance costs showed a more even trend and one with a slightly downward direction. This change in direction was explained in terms of the declining incidence of caries at the older age levels, the gradual replacement of natural teeth by artificial ones requiring less care, and the fact that maintenance care by definition does not permit the accumulation of needs over extended periods.

Age trends on two contrasting cost bases are shown in Chart 9. The solid lines represent the cost to the patient on a fee basis, and the dotted lines, the cost to the clinic estimated on a time basis. The

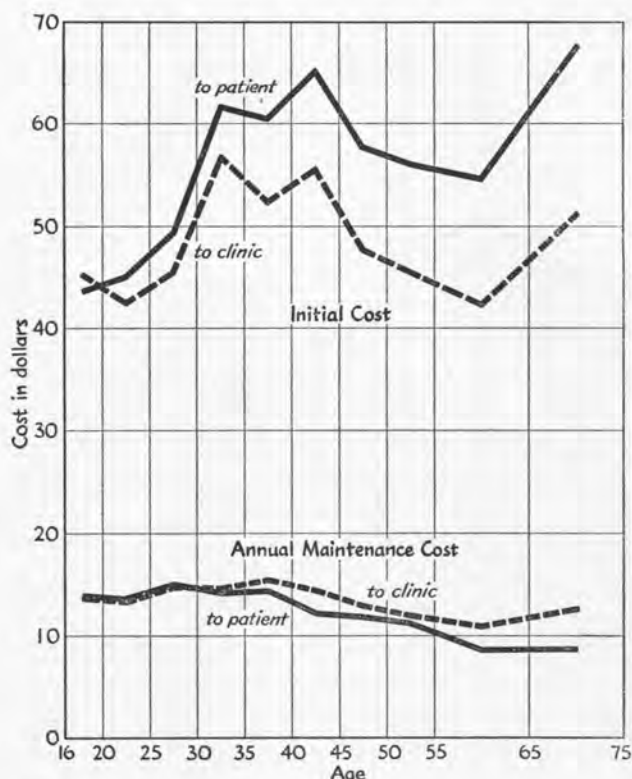


CHART 9. AVERAGE COST TO PATIENT AND AVERAGE COST TO CLINIC OF ALL SERVICES RECOMMENDED DURING INITIAL AND ANNUAL MAINTENANCE CARE, BY AGE.

two types of trends are obviously in contrast. Partially because of the higher hourly return on prosthetic work, and the increasing accumulation of the need for this type of service with advancing age, the cost to the patient of initial care increased more rapidly toward the higher age levels than did the cost to the clinic. Consequently, the surplus from work with older patients was much greater than that from the care of younger ones, as is indicated by the increasing separation between the two types of lines. For maintenance care the relative position of the two cost lines is reversed. Costs to the patient declined more rapidly with age than did costs to the clinic. Consequently, losses to the clinic may be said to have been greater for the maintenance care of older patients than for

that of younger ones. This situation originated in part from the relatively heavy losses on denture repairs and replacements—services needed with particular frequency by older persons.

Corresponding trends for chair-time in relation to age are shown

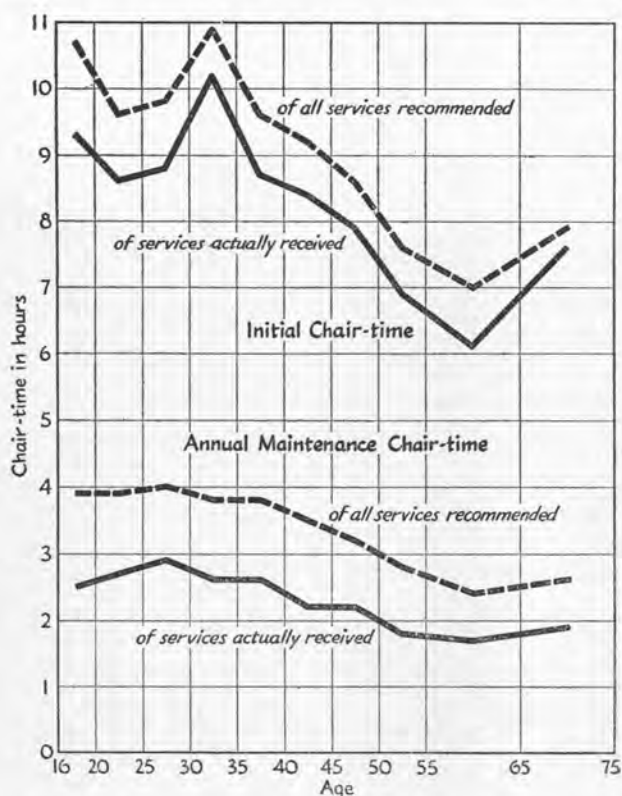


CHART 10. AVERAGE CHAIR-TIME AT CLINIC REQUIRED FOR ALL SERVICES ACTUALLY RECEIVED AND FOR ALL SERVICES RECOMMENDED DURING INITIAL AND ANNUAL MAINTENANCE CARE, BY AGE.

in Chart 10. The maintenance time trends will be seen to be very similar to those for cost. On the other hand, the initial care time trends, in contrast to those for costs, follow a general downward rather than an upward pattern. This major difference in direction can be explained in part as due to the exclusion of laboratory work

in the time figures but not in those for cost, an omission that affects particularly the figures for the older age levels. In addition, the time averages do not reflect the surpluses that accrued to the clinic from initial service for the older age groups.

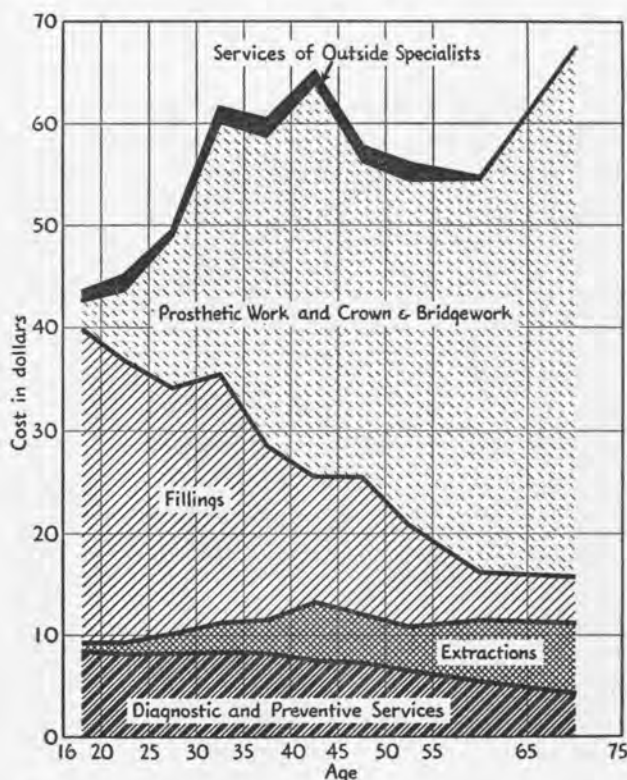


CHART II. AVERAGE COST TO PATIENT OF ALL SERVICES RECOMMENDED DURING INITIAL CARE, BY AGE AND TYPE OF SERVICE.

Chart II explains these age trends further by revealing the components that make up the totals at each age level. One may conceive of this chart as one does of a crosscut of a mountain that lays bare the different mineral strata whose changing thickness at various points accounts for the contour of the mountain peaks and gorges. In this case the strata represent the major types of services

required. The chart is constructed by adding each layer to the top of the layer below until the total bill has been accumulated for each age group. In this case the total line is identical with the top of the section representing the services of specialists. When illustrated in this fashion, the difference between the various age groups with respect to the types of initial services required is very conspicuous. At the oldest age levels prosthetic work and crown and bridgework (primarily dentures) account for about three-quarters of the total initial bill. Extractions, which constitute a necessary preliminary to such replacements, form a smaller component, but are nevertheless much more prominent at the older age levels than at the younger. On the other hand, fillings follow an opposite pattern, the layer representing them becoming progressively thinner as the age level advances. The bottom section representing all recommended diagnostic and preventive services, however, becomes only slightly narrower toward the older age levels, and the top section representing the services of specialists shows no consistent trend.

A composite drawing of maintenance costs following similar principles is shown in Chart 12. At a glance it is apparent that the components of total care assume very different proportions than during initial care. The large proportion of total maintenance expenditures devoted to diagnostic and preventive services is particularly conspicuous, as is also the fact that extractions have disappeared almost entirely. Prosthetic work and crown and bridgework are seen to be still an important constituent of the totals, but this type of service is much less dominant than during initial care. The trends also will be observed to have changed. In contrast to initial care, the need for extractions does not increase with age during maintenance care, and the increase in the need for replacement services is minor. Fillings, however, are seen to decrease with age as before.

From this chart and the one preceding, one can visualize to some extent what changes would be involved for the practice of dentistry if every one actually visited a dentist twice a year throughout his lifetime. Under such circumstances it is obvious that the demand for the services of the exodontist and the prosthodontist, as well as for

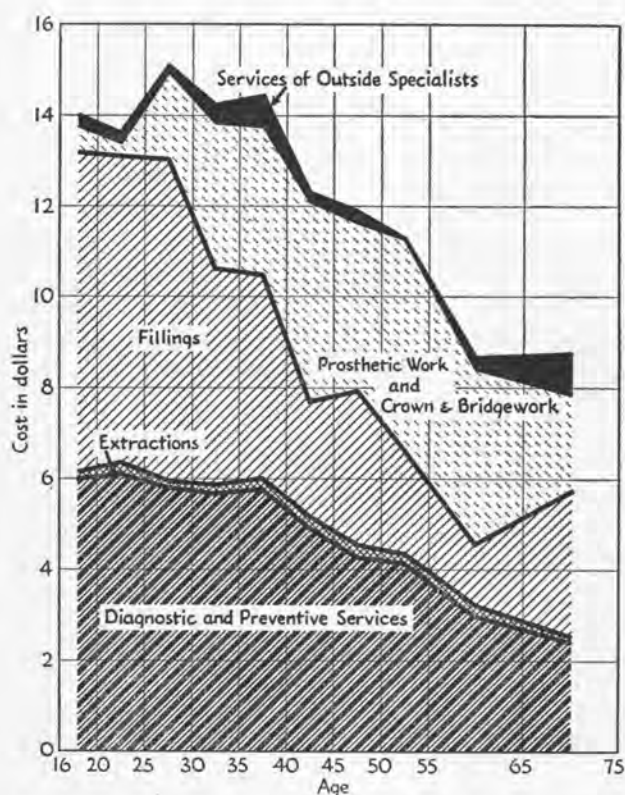


CHART 12. AVERAGE COST TO PATIENT OF ALL SERVICES RECOMMENDED DURING AN AVERAGE MAINTENANCE YEAR, BY AGE AND TYPE OF SERVICE.

the laboratory technician, would diminish greatly, while the demand for the services of the hygienists and x-ray technicians would increase. If the benefits of dentistry could be extended to a much larger proportion of the population than at present, the general practitioner would remain about as busy as before; however, he would find that he must spend his time primarily on small fillings and examinations, to which would be added only occasional dentures, denture adjustments, and remakes, together with various miscellaneous services.

Chart 13 is also drawn on the principle of a mountain cross section, but in this case initial chair-time rather than cost is repre-

sented. As a result, the prosthetic work and crown and bridgework section is considerably less prominent than in the case of the corresponding cost chart, and other services, particularly those of a diagnostic and preventive type, are more conspicuous. As was the case in

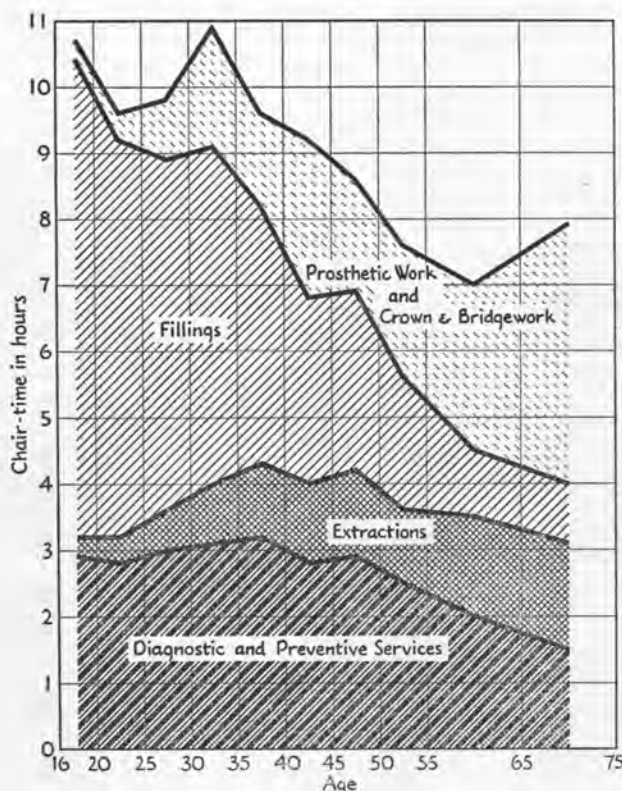


CHART 13. AVERAGE CHAIR-TIME AT CLINIC REQUIRED FOR ALL SERVICES RECOMMENDED DURING INITIAL CARE, BY AGE AND TYPE OF SERVICE.

Chart 10, the total trend line slants downward rather than upward, even though the chart deals with initial care.

A similar analysis of maintenance chair-time is to be found in Chart 14. Here the diagnostic and preventive services dominate the picture even more than in the case of maintenance cost. Since the chart is drawn in terms of all recommended services rather than

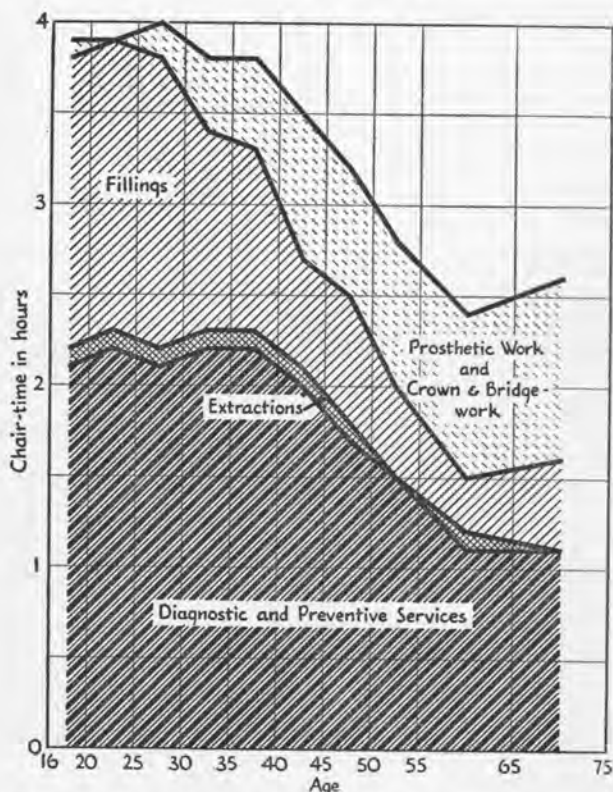


CHART 14. AVERAGE CHAIR-TIME AT CLINIC REQUIRED FOR ALL SERVICES RECOMMENDED DURING AN AVERAGE MAINTENANCE YEAR, BY AGE AND TYPE OF SERVICE.

services actually received, the bottom layer representing these services is thicker than it would have been if only services actually received had been shown. Its relative thickness may be thought of as a general indication of the ratio of hygienists to dentists that would be required if this type of personnel were utilized to provide the recommended prophylaxis twice a year. These theoretical ratios are obviously in sharp contrast to the present ratio of hygienists to dentists.

F. *Findings with reference to sex differences.*—The next four figures illustrate the results of the analysis of sex differences. Chart 15 is confined to the comparison of the two sexes with reference to

the total costs of services actually received. With only two minor exceptions the average male patient at each age level is seen to have incurred somewhat higher initial bills than the average female patient of corresponding age. The existence of this sex difference with respect to initial needs is further corroborated by the findings of other studies. One may tentatively explain this sex difference as due in the main to the tendency of men to neglect their teeth more than women, a trait that all dentists have observed from time to time. This type of interpretation is also confirmed by the fact that total maintenance costs did not reveal a similar difference between the sexes.

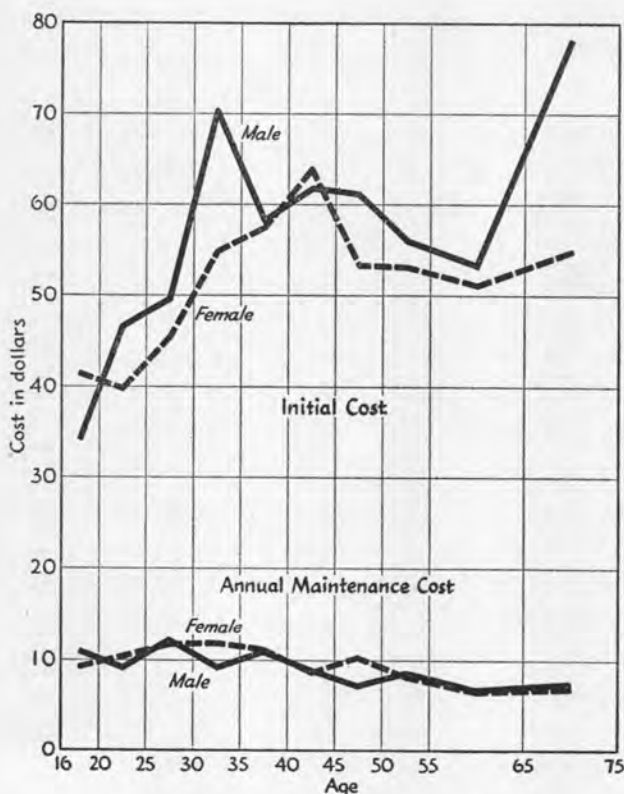


CHART 15. AVERAGE COST TO PATIENT OF ALL SERVICES ACTUALLY RECEIVED DURING INITIAL AND ANNUAL MAINTENANCE CARE, BY AGE AND SEX.

Another interesting sex difference that came to light, but that is not shown in this chart, was the fact that the initial care of men produced a greater surplus for the clinic than did that of women. On the other hand, however, their maintenance care was the source of greater losses. This odd reversal between initial and maintenance care is again due in large measure to the prosthetic work and crown and bridgework component, a type of care needed in larger volume by the men than by the women.

The male and female trends for each class of initial service separately are shown in Chart 16. Since all the services are drawn to the same scale, this chart is also useful for the study of age differences. These differences are obviously much more prominent than are the sex differences. The lines to the right that resemble a skyrocket trace for each sex the increase at the older age levels in the bills incurred for initial prosthetic work and crown and bridgework. Those lines at the left resembling a toboggan slide indicate the decline in the initial cost of fillings at these same age levels. By comparison with these dramatic curves, even the increase in extraction costs by age shown in the left middle section seems inconspicuous. One might readily overlook the fact that patients in the oldest age groups actually had to spend more than eight times as much for initial extractions as did those in the youngest group.

In relation to these marked age contrasts, the sex differences appear minor. The men were usually slightly higher than the women at most age levels in respect to the cost of initial extractions, replacements, and fillings. Although inconspicuous, these differences were nevertheless too frequent and marked for it to be probable that they were due to chance factors alone. Moreover, they have been confirmed by the findings of other initial care studies. Thus it is logical to assume that they reflect real sex differences. The sex differences with regard to the other services, however, were small and irregular and cannot be termed significant without much further study.

Similar types of drawings for maintenance costs by sex are shown in Chart 17. The skyrocket for replacement costs in the previous



CHART 16. AVERAGE COST TO PATIENT OF EACH TYPE OF INITIAL CARE, BY AGE AND SEX. (DATA REPRESENT SERVICES ACTUALLY RECEIVED.)

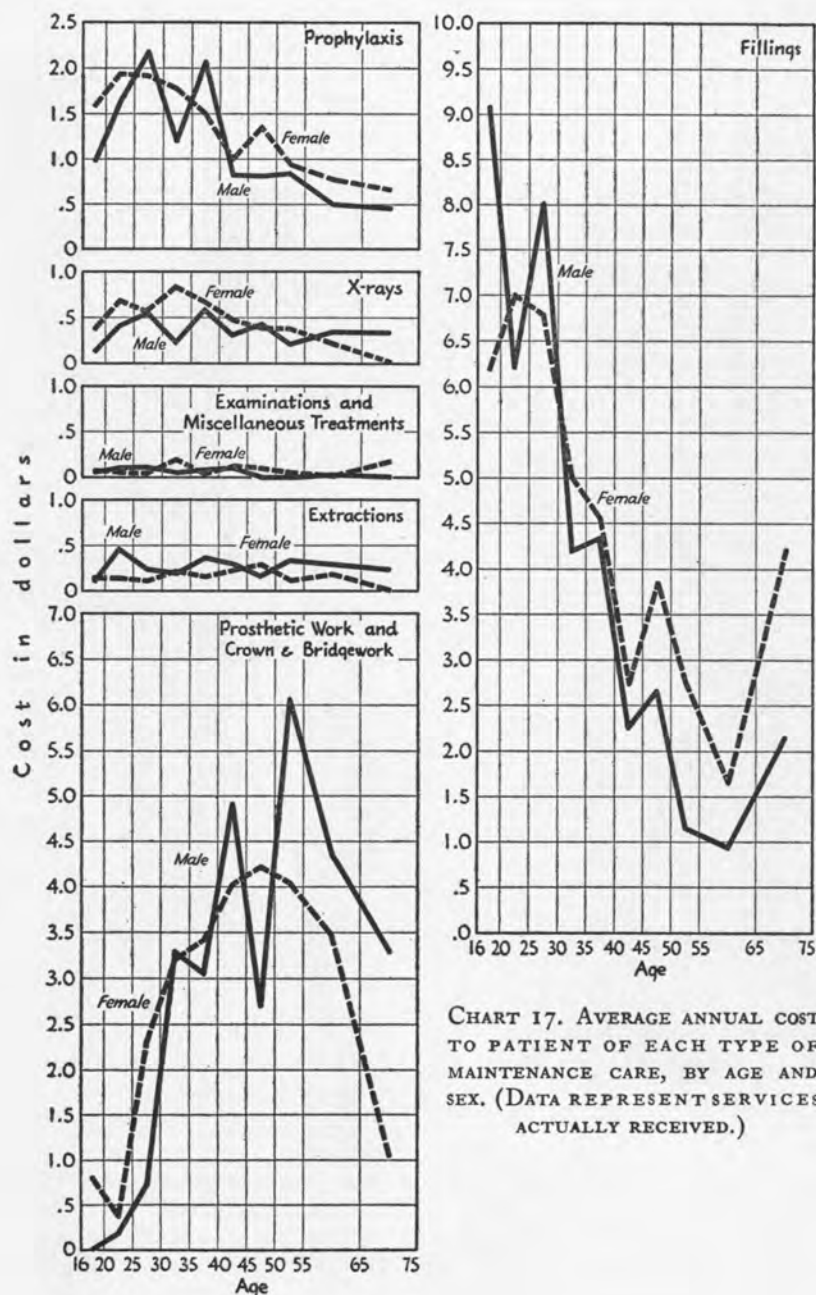


CHART 17. AVERAGE ANNUAL COST TO PATIENT OF EACH TYPE OF MAINTENANCE CARE, BY AGE AND SEX. (DATA REPRESENT SERVICES ACTUALLY RECEIVED.)

chart now looks weak and droopy in comparison, but the toboggan slide for fillings is still very similar in slope to that for initial care fillings. In respect to sex differences, the men continue to be slightly higher than the women in the extraction and replacement service categories even under maintenance conditions. Probably these differences reflect the continuing price of neglect prior to the beginning of maintenance care. The women, on the other hand, now are found to be higher than the men in filling costs rather than lower, the reverse of the initial care situation.

Since sex differences that appear under maintenance conditions are probably more basic than those observed merely during initial care, this difference with respect to fillings was considered worth exploring more fully. In Chart 18 the sex differences in filling needs under maintenance conditions are charted in terms of four different measures; namely: (1) the percentage of cases requiring fillings; (2) the average number of fillings required per case; (3) the average cost of fillings to the patient; and (4) the average chair-time required for fillings. On each of these bases the women are seen to be definitely higher than the men after about 40 years of age. When measured in terms of the percentage of cases requiring fillings during an average maintenance year, the women are found to be higher than the men even from 25 years of age on. These differences were established to be greater than could reasonably be expected on a chance basis. Moreover, since they appeared under maintenance conditions, they cannot be attributed directly to neglect, although it is possible that they are the indirect consequence of the women retaining through better care more of their natural teeth than the men. A number of reasons for this sex difference have been suggested, but the data from the present study do not in themselves indicate the cause. They merely show that there apparently is a definite sex difference that is not due to chance.

G. *Findings regarding differences by denture needs.*—The final two charts give some clue to another factor that is important in determining costs, namely the type of dentures needed or worn. Differences of this type are related in turn to the amount of previous

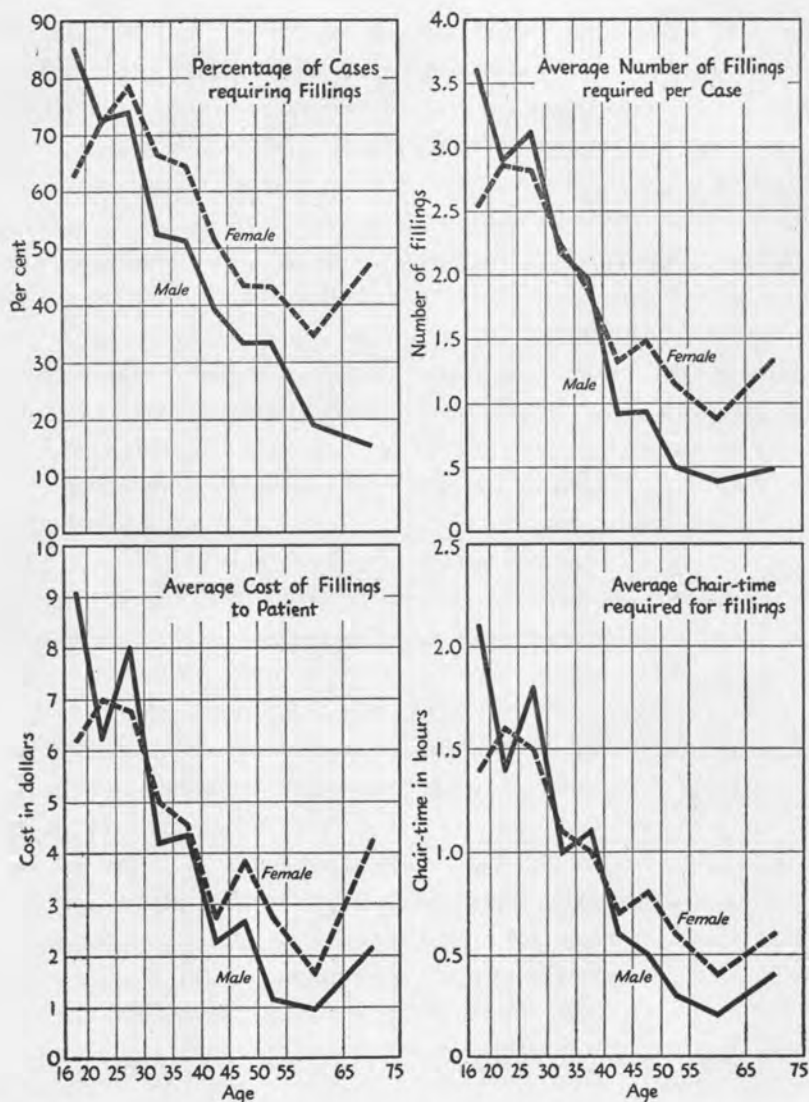


CHART 18. FILLING NEEDS DURING AN AVERAGE MAINTENANCE YEAR, BY AGE AND SEX.

care a person has received throughout his lifetime since such care is the only practical method known for saving teeth. In view of this relationship, denture needs and denture status may be expected to

vary greatly from one social and economic group to another. Hence the importance of understanding the effect of this factor on costs.

The initial aspect of this relationship is shown to some extent in Chart 19, which portrays initial costs in relation to new dentures needed. It is at once evident that the initial bills of these patients varied greatly in relation to the dentures that they required. Those patients who did not need dentures of any type incurred total bills

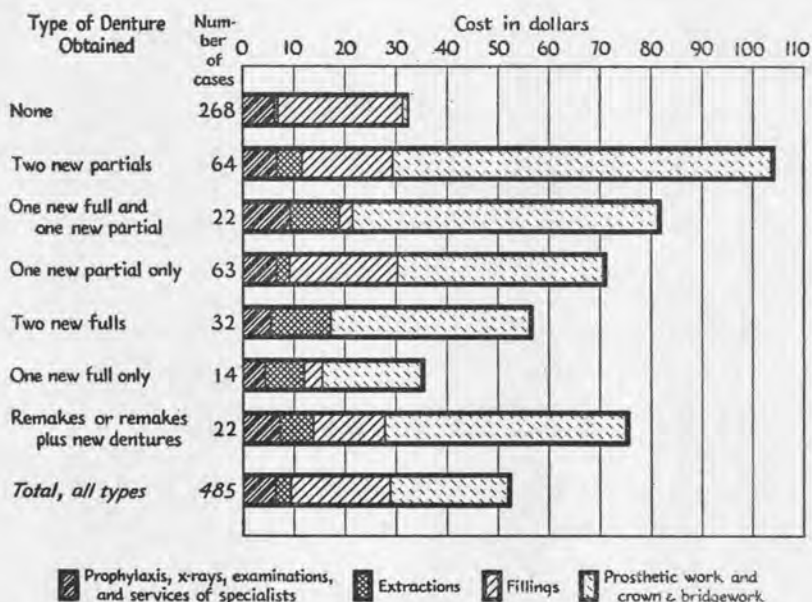


CHART 19. AVERAGE COST TO PATIENT OF INITIAL CARE ACTUALLY RECEIVED, BY TYPE OF DENTURE OBTAINED DURING INITIAL CARE.

averaging only \$32.32, whereas the group securing two partial dentures averaged \$104.08 for initial care, and those securing two full dentures averaged \$56.98. The cost to the patient of meeting other types of initial denture needs took intermediate positions following a pattern consistent with these averages. A glance at the components of the bars indicates further that the cost of the prosthetic work and crown and bridgework secured was the most important factor in determining the total initial cost to the patient.

Although not indicated in this chart, surpluses and losses to the clinic also varied remarkably with the type of dentures needed. It was found in a sample test, for example, that the clinic lost an average of approximately \$7 per patient in the case of those securing no dentures during initial care, while it accumulated substantial surpluses from the initial care of those who did require dentures. These surpluses resulted from fees for these services even though the Dental Health Service charges for work of these types have been set at the comparatively low levels of \$20 for a full upper or lower vulcanite denture, and \$25 for a partial upper or lower vulcanite denture with two clasps.

Chart 20, the final illustration of the findings to be presented, shows the results of a somewhat similar type of analysis of variations in maintenance costs in relation to the type of replacements worn. The results, however, are clearly the reverse of those for initial care. Patients whose initial care costs were low because they did not require dentures are found in this chart to be a high cost group, the average bill to the patient for all recommended maintenance services being in this case \$15.02 annually. On the other hand, those patients who needed two partial dentures or two full dentures as part of initial care, and who consequently incurred high initial bills, now appear as a low cost group. In fact, those wearing two full dentures were found to be the least expensive to maintain, the annual average for such cases being \$2.70 per person. The explanation of this relatively low cost may be attributed primarily to the fact that false teeth do not decay or require x-ray examination or prophylaxis. When costs were calculated in terms of the cost to the clinic, however, the contrasts by type of dentures worn were much less conspicuous, as is apparent from the smaller variation between the length of the solid black bars than between those shaded with slanting lines. It is significant, moreover, that the care of all types of maintenance cases in this classification resulted in a loss to the clinic on all types of maintenance cases except those wearing no dentures whatsoever. The greatest losses occurred in the case of patients wearing two full dentures. In this instance the care that



CHART 20. AVERAGE ANNUAL MAINTENANCE COST TO PATIENT AND COST TO CLINIC IN RELATION TO TYPE OF DENTURE PATIENT WORE AT BEGINNING OF MAINTENANCE PERIOD.

cost the patients an average of \$2.70 per year to purchase cost the clinic \$6.93 per year to provide.

While it is not wise to assume that all the details of these 20 charts have wide applicability or significance, the story they tell is in its major outlines clear and unmistakable. In many respects its major implications for dentistry and the public welfare are far-reaching and fundamental in character. To these we shall now devote our attention.

H. *Implications for private practice.*—Let us think first in terms of the significance of these findings for the private practitioner and the new dental graduate. To those who must interpret daily to their

patients the need for regular care, the findings provide a factual statement of the saving of teeth that can be so achieved. We find this saving greater than has previously been thought possible. The data also provide a graphic picture of the relative economy of regular maintenance care in comparison with high cost of neglect. To the new graduate and to those who must plan major practice policies, they present an analysis of the normal components of practice and of the relationship of fees to cost which has not been previously available. To those who must decide the basic arrangements for partnership and group practice units and for clinics, the findings provide a working basis from which to plan for the division of the labor and proceeds involved. In addition, they indicate very clearly that the profession must teach the public to be willing to pay adequately for examinations, advice, minor fillings, treatments, and repairs if the profession is not to suffer a serious financial loss from a gradual transition to a maintenance type of service, such as is in the public interest.

I. *Implications for cost predictions.*—To the leaders in social planning for whom the study was primarily designed, the data provide some basis for predicting costs on public dental care programs of all types. Detailed figures for one group under one known set of circumstances are provided in sufficient detail so that the averages can be corrected to fit other circumstances. In addition, much evidence is given regarding various factors that must always be taken into consideration in predicting costs and personnel needs and the probable influence of these factors. Finally, the study has made it abundantly clear that maintenance needs and costs cannot be predicted from figures for initial needs. In fact, in many respects, maintenance care is the exact opposite of initial care. We must not rest secure in these findings, however, feeling that this whole matter of costs has been solved. Many types of situations and organizations must be studied before many of the more puzzling problems of dental economics will be clarified. Knowledge and understanding must always be accumulated slowly, bit by bit.

J. *Implications as to the adequacy of the present volume of dental care.*—The use of the findings in cost prediction, however, is

of primary concern only to those who carry responsibility for initiating and planning for projects of one type or another. There are also more general implications that are of significance for all of us. For example, the findings provide some basis for judging the adequacy of the present volume of dental care. You will recall that one of our slides dealt with that problem, namely the slide that compared the volume of various services that our patients received during maintenance care with the amount of similar services secured by the population at large. Similar comparisons can also be made in terms of time and costs.

Let us utilize our time findings for a moment to test the approximate adequacy of the supply of dentists. We found that our patients required about 7 hours of a dentist's time for initial care and an hour and three-quarters for annual maintenance care. These averages may be contrasted with the amount of such time actually available. If all the dentists in active practice in this country were to work full-time at the chair, the number of hours of chair-time that would be available would be almost exactly 1 hour per year per person over two years of age in our population. This is not much more than half the amount of time needed for maintenance care for adults as we found it. From other available studies, an hour per year likewise does not appear to be sufficient for maintenance care for children. Yet in the face of this obvious shortage, the supply of dentists is declining rather than increasing, as you know from the reports of the Council on Education of the American Dental Association.

The supply of hygienists is even more inadequate in relation to need. Our patients were found to require 1.8 hours of time of the dental hygienists for prophylaxis alone during initial care, and 1.6 hours annually during maintenance care. In contrast to these figures, one finds that the number of hygienists in the country is equal to only about 4 minutes per year per person over two years of age—or hardly enough for a single home prophylaxis.

Need and effective demand, however, are entirely different concepts. Much basic dental education in public schools and elsewhere will be needed before the demand will be sufficient to justify the radical increase in dental personnel that these figures indicate is

needed. Moreover, dental health education must be accompanied by an expansion in the facilities for care for low-income groups if the demand thus stimulated is actually to be met.

A comparison of our cost findings with per capita expenditures for dental care by the general population tells the same story of gross inadequacy. At the low income levels, expenditures of a dollar per year per person for dentistry are typical findings. In comparison with our \$13.87 cost figure for adequate maintenance care, these averages of less than a dollar suggest that this group in the population is purchasing little more than emergency service for the relief of pain. In most population groups one must look for families having annual incomes above \$5,000 per year before one finds average expenditures for dentistry that equal the amount that maintenance care cost for the patients whom we studied. The average per capita expenditure for dental care for consumers at large is less than a third of the cost of maintenance care for these Dental Health Service patients.

K. *Dental care in the family budget.*—These figures give you some glimpse of the extent of the adjustments involved in the practice of dentistry if dental care is to be provided as a health service to the entire population. Approaching the same problem from another angle, we can visualize likewise the readjustments necessary in the individual or family budget if funds for adequate dental care are to be secured by economies in other items. An extensive federal consumer survey in the years 1935 and 1936 reported average per capita income in that period to have been about \$470 per year. Almost half of this amount was spent for food and housing. All the other major expenditure categories showed annual totals below the cost of initial care for patients included in the present study. Consumer expenditures for clothing averaged \$42 per person; those for household operation, \$42; and those for automobiles, \$30. Even funds laid by as savings averaged only \$47. Expenditures for medical care of all types, including dentistry, averaged less than twice the cost of dental maintenance care for our patients, or only \$18 per person per year. Per capita consumer expenditures for recreation, household furnishings, personal care, tobacco, transportation except

by automobile, reading, and personal expenditures for education, each fell below our average for the cost of adequate dental maintenance care to the clinic. One does not have to assume any exact representativeness for our data to conclude that the purchase of dental care on an adequate level would require major readjustments in the current expenditure pattern. If the cost of dental maintenance care for our patients were added to the cost of adequate medical care of other types, which has been estimated to average about \$25 yearly if provided on a group basis, the total would approach \$40 per person per year. For the lowest third of the families in this country with total family incomes under \$780 per year, or for the middle third with incomes from \$780 to \$1,450 per year, this cost could be met only with much difficulty, if at all.

L. *The cost of dental maintenance care for the dentally indigent.*—These figures provide a picture of the problem from the point of view of the individual or family. The problem of government is of lesser scope. It may be thought of in terms of how to provide for those who are unable to purchase adequate dental care for themselves. The federal government has estimated that there are about 27 million adults in families with incomes below \$800 per year and has classified these persons as unable to purchase essential medical service under any system and as in need of medical care from tax funds. The number of dentally indigent may be assumed to be at least equal to the number of medically indigent. If one assumes, in addition, that adequate maintenance care for this group would cost \$13.87 annually, the total yearly cost of care for these adults would be about 374 million dollars per year. This figure actually is a little high for this generation since there would be a relatively large group of edentulous persons at these low incomes and since the members of this group have not been educated to make use of care of an adequate standard. Nevertheless, in the absence of any more appropriate maintenance average, this one may be used. Any surpluses probably would be needed to cover the cost of lapses in regular care. If this average is accepted, it may be visualized as equal to all the educational and general expenditures made by institutions of higher education in this country in 1933-34. From an-

other angle, it may be thought of as approximately eight-tenths of total payments to recipients of old age assistance in 1940, or as about seven-tenths of the total governmental expenditures for medical services in 1935. It would represent one-half of one per cent of the national income in 1940. Moreover, for an adequate program for all age groups, the cost of the care for about 13 million children would have to be added to the total.

I am purposefully omitting estimates of initial costs for these dentally indigent adults since initial needs can be met gradually. Demand may be expected to develop slowly as new facilities become available and the values of the care that can be secured become more widely appreciated. For the next generation, if maintenance care is begun at a sufficiently early age, initial care need never be a problem. However, until we find other means for checking dental diseases, maintenance care will be a continuing cost that must be reckoned with.

M. *Dangers involved in the cost of adequate care.*—While these comparisons and this estimate open up a vista of new possibilities for expansion and service by the profession, they also serve as a danger signal. The high cost of adequate dental care can have unfortunate consequences. It is obvious, for example, that the sums involved are sufficiently large to compete in a major way both with budgets for public medical care of other types and with funds for other social services, such as education and welfare. This competition for limited public funds by a number of worthwhile projects inevitably will create intense pressures for inexpensive dental programs of low standards. Some of the unfortunate results of such excessive economies have been well illustrated by European experience. On the other hand, if the alternative solution is chosen and the attempt to include dentistry is abandoned entirely, then the expansion of other public medical services will go forward leaving dentistry out of the total plan. This result has the unfortunate effect of depriving the patient of one essential portion of a coordinated health service program. Moreover, since dental care is a basic and essential health service, it cannot long be wholly ignored. If pushed out of the front door as too expensive, it has been found to squeeze in through the

back door in the guise of dental care prescribed by physicians, dental services performed by physicians or technicians, and similar substitute solutions that tend to place the dental profession in a very difficult position.

N. *Possible methods for the solution of the problem of cost.*—In view of these very serious possible consequences of the present cost of adequate dental care, it is important that every available means for meeting these costs be explored to the full. In general, proposals for meeting the problem fall naturally into four categories: (1) prevention; (2) economical methods of distribution; (3) limitations in the amount of service provided; and (4) other methods of payment. I will take time to comment briefly on the possibilities for a solution along each of these lines.

I PREVENTION.—Since there is no known method of preventing the occurrence of initial carious lesions, prevention in the dental field must consist in the main of the early detection and filling of small cavities, especially in children. This is the only method by which excessive tooth loss and high initial costs for adults can be avoided. Since this method of meeting the problem has been stressed at some length by others, I need not dwell on the point, basic though it is.

For the finding of any less time-consuming or less expensive method for the prevention of caries, one must look to research. This avenue of approach has more ultimate promise than any other, and it must not be neglected under any circumstances.

Nevertheless, research alone or children's care alone will not meet the demand of the times. The dental needs of the population cannot wait until the key to genuine prevention is found. The development of plans for the extension of dental care for adults must go forward along with the search for a solution through scientific methods and the intensification of work for children.

2 ECONOMICAL METHODS OF PROVIDING CARE.—The attempt to solve the problem by the second method named, that of devising more economical methods for providing care, conceivably might involve any, or all, of the following approaches: (1)

economies in administration through the use of a clinical or group-practice method of providing care, (2) relatively low salaries for the dentists who provide the service, (3) the maximum possible productive use of the time of the staff providing the service, (4) reductions in the cost of materials and supplies through large-unit purchases and through the use of the cheapest materials that meet satisfactory standards, (5) the maximum use of auxiliary workers now permitted by law, and (6) the extension of the use of auxiliary workers beyond the present legal limits. With a few minor exceptions, the data from this study do not indicate the economies that can be achieved by any of these methods. They will have to be determined by research and experimentation. In decisions on these matters, it is important that the dentists and the public leaders distinguish clearly between legitimate economies that may have a definite contribution to make toward the solution of the problem and economies that are basically or ultimately harmful to the interests of the patients or to those who provide the care. In view of the scope of the task even when considered in minimum terms, it is essential that every legitimate economy be exercised.

3 LIMITATION IN THE AMOUNT OF SERVICE PROVIDED.—In addition to economies in the provision of service, there are numerous ways in which the bill may be cut through the limitation of the amount of service provided. One can confine one's efforts to children, or to children and those adults who are in a position to utilize maintenance care immediately. As another alternative, one can restrict the care to certain types or groups of adults, or again, one can limit the level and type of service provided. For example, one might omit all prosthetic work and crown and bridgework, or one might give only such care as is needed for general health reasons.

All of these policies have the obvious disadvantage that they do not meet the total problem. Either they leave some without care of any type, or they provide a very unsatisfactory level of care to a larger number. Who is to take the responsibility for decisions as to who is to be favored with the advantages of dental

care from tax funds and who, on the other hand, is to be left to endure dental ill health? Or is it better that larger groups be restricted to extractions only, or extractions and fillings, or some other drastically limited service?

The dental profession must be equipped to contribute toward the solution of these basic issues by the expression in the early planning stages of clear convictions, based where possible on a sound research foundation, as to what policies and procedures are of the nonessential type and which are basic to satisfactory dentistry for all social classes and should therefore be protected regardless of other consequences. Although it is obviously impossible for the entire population to receive immediately an adequate standard of care, it is likewise unwise that newly developing programs set a pattern of care so inadequate that if such care were widely extended, it would prove entirely unsatisfactory in the long run.

4 OTHER METHODS OF PAYMENT.—For the solution of the cost problem through other methods of payment, four types of proposals are commonly made: (1) the donation of service by the profession, (2) improved credit facilities, (3) insurance, and (4) governmental subsidy. What, then, are the potentialities of each of these?

6. THE COST PROBLEM: METHODS OF PAYMENT

When the size of the problem is considered, it is obvious that the first of these, namely the donation of service by the profession, is impractical. If the cost of dental maintenance care alone for the 27 million dentally indigent adults, as previously estimated, were divided equally among all the dentists in active practice in this country, each dentist's share of free service would amount to \$5,500 per year, or almost double the average net income of dentists in 1937. Thus, while this method can alleviate the sufferings of occasional individuals, it cannot be employed on a wide scale without loading on the dentist an impossible and unjustifiable burden and restricting the volume of service available to those in need to an extremely inadequate level.

The second method suggested, namely the improvement of credit facilities, can play a useful, although limited, role in meeting the problem. There are always some who are able to pay for services on the installment plan that they cannot succeed in paying for on a cash basis. The technic is particularly helpful in the case of large initial bills. Prolonged credit seems a less reasonable solution, however, when applied to maintenance care bills which may be expected to reoccur with some variation year after year. Credit is also of little use in meeting the problems of those numerous individuals who cannot pay for essential medical services of any type under any method of payment without depriving themselves of other essential services. Of these, you will recall, there are at least 27 million adults, as well as 13 million children.

The insurance technic has some promise for marginal income groups as a means of payment for maintenance care. It would serve to spread the costs over periods of time and over groups of people. Insurance, in the strict sense of the term, could not be applied to initial care, however, since initial needs are already present and hence are not insurable. In addition, insurance is of little, if any value to the dentally indigent since they cannot pay the premiums.

The conclusion is inescapable that for large groups in the population the extension of tax-supported dental care offers the only possibility of a satisfactory solution of the problem of cost. The estimates of the cost involved in providing adequate dental maintenance care to the dentally indigent that have been given should make it unmistakably clear that neither professional charity nor private philanthropy in general is equal to the task of providing for this large group. Private initiative and contributions can perform much needed pioneer work in the development of new types of programs for both children and adults and in the encouragement of basic dental research. Until a method of prevention is found, however, the only hope for the 27 millions dentally indigent lies in publicly financed, large-scale dental programs. The rapid expansion of such programs has formed the dominant pattern of the changing economic relationships of dentistry during the last decade, and there is every reason to anticipate a continuance of this trend. Nevertheless, American tra-

dition and economic practice set natural limits to the extension of this form of payment for dental care. Thus even government subsidy provides no universal answer, any more than do the other types of proposals that have been reviewed.

7. CONCLUSION

In conclusion, one is forced to admit the need for a coordinated use of all available methods, but that the problem of how to furnish and finance adequate dental care for the entire population is not subject to any simple or immediate solution. Probably several generations of intensive effort will be required before adequate dental care can be made universal. The realization of this end will require the participation of private practitioners, the dental schools, and professional and public leaders of all types. All available methods for easing the cost problem must be explored to the full, their contributions utilized, and their dangers avoided. Moreover, the changes needed must be introduced gradually and in a coordinated manner. In the present stage the pattern for future large-scale developments is being set. It is urgent that this pattern be shaped along the best possible lines.

The role of the profession in the moulding of this pattern will be more constructive and more influential, and the end result more satisfactory to both the public and the dental profession, in direct proportion to the amount of thorough, farsighted, and impartial consideration that the dental profession has given to these major questions of policy that are the outgrowth of the inevitable cost of an adequate program of care. It is with this conviction that the current research program of the Socio-Economics Committee has been undertaken and carried forward. More such studies are needed. Only through continuous and intelligent participation in general medical and social planning can dentistry hope ultimately to take its rightful place in a total health service program for the entire nation.

AMERICAN COLLEGE OF DENTISTS

SALIVARY AND BACTERIOLOGICAL CONSIDERATIONS IN THE CONTROL OF DENTAL CARIES¹

HERMANN BECKS, M.D., D.D.S.

San Francisco, California

Developments in the field of caries research in recent years have emphasized the fact that the success of preventing and controlling dental caries depends for the main part on a sound understanding of those factors which promote or eliminate the growth of aciduric microorganisms in the oral cavity. Today various institutions are engaged in studying the ecology of the many types of organisms of the mouth and we seem to get further away (at least on the surface) from former suspicions and preconceived ideas that deficiencies in calcium and phosphorus or Vitamin D are directly responsible for the development of caries and that their administration would successfully arrest the condition. The latter point of view is still frequently found among practicing dentists and investigators for whom it is difficult to conceive that the destruction of enamel and dentin is asimilar to that of bone and that it seems to be rather the result of a local than a systemic condition. We are all aware of the fact that new data and observations, as well as new experimental investigations and studies are required, in order to advance our present knowledge to the point where prevention can be based on sound biological principles. For the purpose of this presentation, I have selected some recent findings of the University of California group which deal with salivary calcium and phosphorus studies and certain nutritional and bacteriological aspects in relation to the caries process.

With regard to the *saliva aspect*, it can be stated that the frequently voiced suspicion and belief by many investigators and clinicians that the oral fluid bears the solution of the caries problem because of the fact that it bathes the teeth and also because it shows tremendous fluctuations in mineral composition from day to

¹Read at the Convocation of the College, Houston, Texas, October 26, 1941.

day and from week to week, has not found as yet scientific substantiation. Determinations of the hydrogen ion concentration of the products of the various salivary glands, the alkali reserve, proteins, mucin, viscosity, even urea and ammonia, calcium, phosphorus, magnesium, potassium, sodium, chlorides, etc., have not uncovered any definite relationship with the presence or absence of dental caries. Attempts by investigators such as Enright, Friesell and Trescher; Forbes; Karshan and Rosebury, as well as Fosdick and Stark, Gore, Price and others, to explain the decay process on the basis of the degree of saturation of the calcium and phosphorus of saliva or the "solubility product principle," have failed so far to give us the desired answer.

Contradictory results have been reported in salivary work, especially on the mineral composition with regard to calcium and phosphorus content. The findings of various authors were recently analyzed by Karshan² who came to the conclusion that caries-free individuals have a higher salivary calcium and phosphorus composition, expressed in mg.%, than caries-active individuals. Such a relationship has been definitely denied by others (White and Bunting). It must be realized that the establishment of significantly different calcium and phosphorus levels for caries-free and caries-active individuals would constitute a rather important finding if confirmed in every respect. However, the fact alone that milligram per cent values for calcium and phosphorus of mixed human saliva vary to some extent with the rate of salivary secretion and age of the individuals (Becks and Wainwright), raised the question as to whether the far-reaching conclusions drawn from analyses of contrasting caries-free and caries-active groups are actually valid. It was felt that additional data and observations were required in this field.

The question of obtaining a satisfactory number of caries-free or "caries-immune" individuals presented a real problem. The compulsory student health service, including dental examination, at the University of California campus in Berkeley, finally offered a solution. In the course of routine student examinations at the be-

²Karshan, Maxwell: Biochemical Aspects of Dental Caries. *Dental Science and Dental Art*, p. 331, Table 24. Lea and Febiger, Philadelphia, 1938.

ginning of each academic year, over 200 completely caries-free individuals were found during the last three years, who had never experienced caries and who had a full complement of teeth. Of these two hundred students, ninety were available for salivary studies and a contrasting group of one hundred and eight caries-active individuals, some with more than twenty open cavities, were used for comparison.

The tests for caries activity vary greatly with different investigators. In many instances caries activity is determined by checking the consistency of disintegrated enamel and dentine with an explorer. If it is found to be soft, caries activity exists. If it is hard, the caries process has been arrested. It is obvious that this test presents an obvious weakness, because of the great possibility of errors. In other studies it has been suggested that caries susceptibility or immunity be established by an immediate test such as that of Bunting and Jay. The determination of the *Lactobacillus acidophilus* index (Bunting and Jay) was made for these two groups and showed that 95% of the examined caries-free individuals were negative, while 86% of the examined caries-active group had extremely high counts, rising as far as 300,000 colonies and more. These findings confirm the contention of the Michigan group that there is a direct relationship between the presence of aciduric microorganisms and caries activity.

After the two groups were thus tested their resting salivas were analyzed for calcium and phosphorus composition. When the data were accumulated it was found that the arithmetic means showed only a very slight difference between the caries-active and caries-free groups, which from a statistical point of view was *not* significant. However, in order to determine whether some of this difference was due to differences in age and rate of flow, fifty individuals of each group which were comparable in these respects were evaluated again and it showed (Table I) that even this slight difference disappeared and that the calcium and phosphorus values in both groups were practically the same. This again emphasizes the fact that variations in rate of flow and differences in age exert a profound influence on the salivary calcium and phosphorus results,

regardless of the presence or absence of dental decay. This investigation, therefore, emphasizes the lack of any relationship between salivary rate of flow as well as calcium and phosphorus composition of mixed human saliva and caries activity.

TABLE 1.

Salivary Analysis of Fifty Caries-Free and Fifty Caries-Active Individuals.

	—RANGE—		AVERAGE (M)	
	CF ³	CA ⁴	CF	CA
Age	15-24	15-24	19.54	19.96
Rate of flow, cc/hr.	11.2 -49.2	11.0 -48.0	21.50	21.40
Total Calcium, mg.%	3.75- 9.25	4.0 - 7.60	5.74	5.73
Total Calcium, mg./hr.	0.58- 3.05	0.53- 3.10	1.20	1.23
Inorganic Phosphorus, mg.%	7.7 -22.60	6.3 -23.2	13.24	12.28
Inorganic Phosphorus, mg./hr.	1.27- 4.69	1.05- 7.42	2.96	2.64

³CF = Caries-free.

⁴CA = Caries-active.

From a *bacteriological* point of view, the above findings presented rather convincing evidence that in the majority of individuals caries freedom is accompanied by the absence of *Lactobacillus* while the reverse holds true in rampant caries cases. Because of the large number of students available for this purpose and our desire to further study the question of a relationship between dental caries and the presence of *Lactobacillus acidophilus*, the saliva of three additional groups of one hundred and twenty-two students each were tested bacteriologically. (Table 2.) Group I consisted of one hun-

TABLE 2.

Lactobacillus Acidophilus Studies of Three Hundred and Sixty-six Individuals.

Group (each consisting of 122 individuals)	Lactobacillus Acidophilus	No. of Cases	Percentage
I. Caries-free	High	23	18.9
	Zero	99	81.1
II. Active or Inactive	High	50	40.9
	Zero	72	59.0
III. Rampant Caries	High	107	87.7
	Zero	15	12.3

dred and twenty-two students who were clinically (by mirror and explorer) and roentgenographically free from dental caries; Group II showed no caries on clinical examination, but definite evidence of enamel defects, primarily under contact points. Sometimes the involvement reached deep into the dentine. In some individuals of this Group II, from 4-28 involved areas per person were found. Group III had rampant caries with five or more open cavities evident to clinical examination in addition to numbers of filled cavities.

Table 2 demonstrates the very high percentage of negative counts in the caries free, Group I, in ninety-nine out of one hundred and twenty-two cases, i. e., 81.1%, while only 18.9% had high counts. The reverse can be observed in the rampant caries Group III with one hundred and seven, or 87.7%, having high counts and only fifteen, or 12.3%, with negative counts. These observations confirm the previous findings and support the concept of the Michigan group that a striking correlation exists between the presence or absence of *Lactobacillus acidophilus* and caries activity or caries freedom, respectively.

Group II, which presented several areas per person in the form of small nicks in the enamel with sometimes deeper involvement of the dentine, showed a larger number of zero counts, i. e., 59%, while in 40.9% the counts were high. This finding seems to indicate that more than half of this group were caries-inactive in spite of roentgenographic evidence of defects which might have been formed many years previously and then had entered an inactive phase.

It will be most interesting to observe whether in years to come those individuals with no caries experience and high counts will finally develop cavities and those with rampant caries and no counts become entirely inactive. Their dentures are being checked every year.

In a further attempt to analyze the food intake of the students of Groups I and III who had predominantly zero and high counts, respectively, their *nutritional status* was appraised as to protein,

TABLE 3.

Nutritional Analysis of Ninety-nine Caries-Free and One Hundred and Seven Caries-Active Individuals.⁵

	A—CARIES-FREE					B—CARIES-ACTIVE				
	B.A. Negative—99 Individuals					B.A. Positive—107 Individuals				
	1 +	2 +	3 +	4 +	%	1 +	2 +	3 +	4 +	%
Protein		1	6	92	98	..	4	13	90	95.0
Calcium	1	14	13	71	89	..	11	14	82	91.6
Phosphorus		2	5	92	97.7	..	5	12	90	94.8
Carotene		18	60	21	75.7	1	6	99	1	73.3
Thiamin		91	8	..	52	2	104	1	..	49.8
Ascorbic Acid	1	12	37	49	84.8	1	12	33	61	86.0
Vitamin D		2	38	59	89.5	25	82	94.1
Concentrated										
Sweets	10.5 t.					18.2 t.				

calcium, phosphorus, carotene, thiamin, ascorbic acid, Vitamin D, and carbohydrates.⁶ The survey (Table 3) showed clearly that these food essentials, checked in this appraisal, were not more adequate in the caries-free group than in the caries-active group and on the basis of nutritional adequacy or any concept of a so-called "optimum diet," no one group was superior to the other *and yet one developed rampant caries while the other remained caries-free*. It appears therefore doubtful, through these studies, that the caries incidence can be favorably influenced by increasing certain food elements as is so vigorously advocated currently.

The only difference in the nutritional intake of the two groups may be found in the carbohydrate consumption, with special regard to the refined sugars. Here we find that the caries-active group consumes an average of 7.7 teaspoonsful more per day than the other group. It must be concluded, furthermore, that the higher carbohydrate intake in the caries-active group which is associated with high bacillus acidophilus counts and high caries incidence, indicates a direct relationship between three factors: refined sugars,

⁵Collins, Russel O., Jensen, Arthur L., Becks, Hermann: Study of Caries-free individuals. II. Is an optimum diet or a reduced carbohydrate intake required to arrest dental caries? To appear in the July issue of the *J.A.D.A.* (Vol. 29, No. 7).

⁶Through personal interview with each student and a seven-day recording of food intake.

Bacillus acidophilus, and dental caries. Therefore, a reduced sugar consumption seems to come closer to the solution of dental caries prevention than does nutritional adequacy.⁷

Additional studies of more than five hundred rampant caries patients, who have applied for dental therapy at the University of California and who have been under observation for the past three years, have given further support to the impression that the reduction of the *Lactobacillus acidophilus* count can be attained at least by *one* means, namely, by decreasing excessive amounts of refined sugars, and that subsequently the caries process becomes arrested.

⁷This, of course, does not exclude the desirability of correcting faulty food habits from a strictly medical point of view.

AMERICAN COLLEGE OF DENTISTS

PROCEEDINGS OF THE HOUSTON CONVOCATION, OCT. 26, 1941

REPORTS OF COMMITTEES

(Concluded from the March issue, pp. 44-70)

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VIII. PROSTHETIC SERVICE¹

WALTER H. WRIGHT, D.D.S., Ph.D., *Chairman*
Pittsburgh, Pa.

The Committee presents its annual report with a feeling of loss and grief occasioned by the death of one of its members, Dr. A. H. Paterson of Baltimore, Maryland. Dr. Paterson, through his long experience with laboratories, his practice of prosthetic dentistry, and his eminence as Professor of Prosthetic Dentistry in the School of Dentistry of the University of Maryland, was especially qualified for the duties of membership in this Committee. His judgment was sound, his enthusiasm unbounded, and his faith in the future of dentistry unshaken. He no longer labors with us, but the influence of his life and his works which have helped to elevate dentistry, will remain with all those who knew and loved him.

With the present rapid expansion of dental service in the Army and Navy, the question now arises as to the status of dental technicians in those branches of service. A study of each has been assigned to each of two members of our Committee, and are included herein as part of our report.

I. PROSTHETIC SERVICE IN THE ARMY

C. A. NELSON, D.D.S.

Dentistry has become recognized as an essential health service in the Army since the last World War. During the last war adequate equipment, trained personnel, and facilities for desirable results were seldom available. The Army had provided small dental laboratories

¹The other members of this Committee are: W. H. Grant, C. A. Nelson, A. P. O'Hare, A. H. Paterson.²

²Deceased.

containing the usual equipment for every station, but trained mechanics were not available and the dental surgeon seldom had time to observe laboratory routine. The same reason given by a busy dentist in private practice needing efficient laboratory assistance was cited as the reason for little denture work being done in the Army during that period. Furthermore, because Army regulations placed the responsibility for dental health services squarely on the shoulders of the Dental Corps, it was essential that an adequate plan be provided for denture service in the Army during the present conflict.

Dental service is established in every military hospital and dispensary in the Army. As there are large and small Army units requiring denture services, five large laboratories, *other than those in the larger hospitals*, and suitably located throughout the country, have been set up.

In the execution of such a plan the Dental Corps was confronted with two major problems: first, the administration of the laboratory, and second, the procurement of trained personnel. Dental officers, with special training will be in charge of the laboratory, completely control them, and dominate the laboratory service. This means co-operation between the dental clinics and the laboratories, and complete control of the laboratory and technicians. The dental officer will survey each incoming case and his instructions concerning fabrication will be carried out by the technicians. Only the best equipment and the best approved denture techniques are provided.

As proper dental technicians are essential to this plan, the courses for laboratory technicians have been intensified by the Army Dental School. A twelve-month course is provided. The course of study consists of dental anatomy, physiology, metallurgy and dental materials. The many steps in full and partial dentures, casting, crown and bridge work, and all other procedures in training an efficient technician, are thoroughly presented. The denture service of the Army during peace time requires fifteen dental officers and one hundred technicians. In 1940, 17,000 dentures, bridges and repairs were made.

The attitude of the Army has changed relative to pulpless teeth. In 1920, 20,000 root canals were filled and 69,805 teeth extracted.

In 1938, 874 root canals were filled and 89,842 teeth extracted. Defective teeth with the pulps involved are now extracted. This calls for an expanding laboratory service.

Plans creating laboratory facilities to meet the needs for denture service provide for spacious laboratories at the large training centers. In addition to the central dental laboratories now in existence, a dental laboratory will be established in each divisional camp. Also, two other types have been planned for large troop concentrations, one consisting of three dental officers and twenty-five technicians, and the other staffed by six officers and fifty technicians, the type to be adopted being contingent upon the size of the camp. These are designed for a complete laboratory service with all the facilities required for the most desirable type of replacements.

Mobilization constitutes a great problem, but when the troops move from training centers into the theater of operations to engage in combat, we are confronted with other demands and newer problems. The theater of operations is divided into two main sections—the communication zone and the combat zone. In the communication zone will be found the large establishments for supply, the many troop centers and the many large hospitals and other installations set up to provide medical care for battle casualties; while in the combat zone will be found the troops in the battle area and those supporting them. In the communication zone, the many different types of medical department units are established in fixed or permanent buildings; but, in the combat zone, all units are mobile and consist only of the absolute necessities for treating war casualties and transporting the injured from the combat zone to the large hospitals in the communication zone.

In the theater of operation splints of all types are available in the general hospital of the communication zone. In the combat zone one per cent of the division personnel will require denture service upon returning to camp in the rest area. A mobile laboratory unit has been provided to meet this need. There are six of these units in the Army. The personnel of each unit consists of one dental officer (prosthodontist) and three dental technicians.

Comment: The dental profession can look with favor on the

basic plan of the Army in the set-up for Prosthetic Service. The following features are commendable:³

1. Dental officers with special prosthetic training are in charge of the laboratory and have complete control of them, thus dominating the service.
2. Dental officers survey each case and give instructions for fabrication to the technicians.
3. Dental technicians are trained in the Army Dental School. By this arrangement the profession controls their training.
4. Laboratory units and large central laboratories are established throughout the country and are under complete control of the Dental Corps of the Army.

2. PROSTHETIC SERVICE IN THE NAVY

W. HENRY GRANT, D.M.D.

The report on the status of dental technicians in the Navy is contained in the following two letters from Captain A. Knox of the Dental Corps of the Navy:

D:HGB

DEPARTMENT OF THE NAVY
BUREAU OF MEDICINE & SURGERY

Washington, D. C., June 3, 1941.

Dear Doctor Grant:

In answer to your letter of May 28, 1941, requesting information regarding the status of dental technicians in the Navy, the following data are given:

1. *Procurement:*

Candidates for the designation of dental technician are selected from enlisted men who have at least thirty months of obligated service in the Navy.

A qualified dental technician may be enrolled from civilian life in the Naval Reserve as pharmacist's mate, second class, or in a lower rating.

2. *Rating:*

Dental technicians have the following ratings, depending on service in the Navy, ability, knowledge of their specialty, conduct, and leadership: chief pharmacist's mate; pharmacist's mate first class, second class and third class; hospital apprentice first class and second class.

3. *Designation:*

Dental technicians are designated (general) or (prosthetic), depending on their qualifications.

³Burbank, L. C., D.D.S.: Prosthetic Dental Service for the Army in Peace and War; *J.A.D.A.*, 28, 798; 1941, May.

4. *Training:*

(a) Candidates for the designation dental technician (general).

These men receive a course designed to fit them to assist the dental officer in the dental operating room, to care for dental supplies and equipment, and to render, under supervision, dental prophylactic treatment.

(b) Dental technicians (prosthetic).

Technicians (general) may, if aptitude is shown, be given a course designed to fit them to perform the work of a dental mechanic, and upon the successful completion of such a course they are designated dental technicians (prosthetic) and, in so far as conditions of the service permit, are employed in that capacity.

5. *Pay:*

The base pay ranges from \$36.00 per month for hospital apprentice, second class, to \$126.00 per month for chief pharmacist's mate (permanent appointment). There is an addition of ten per cent after the first four years' service and of five per cent for each subsequent four-year period, the total not to exceed twenty-five per cent.

6. *Number:*

The ratio of one and one-half technicians per dental officer expresses the proportion set forth in the policy established by the Bureau of Medicine and Surgery. However, this ratio has not been reached nor maintained for various reasons.

7. *Service:*

(a) Service alternates between sea and shore and comprises duty in the larger ships at sea and in training stations, navy yards, hospitals, air stations and Marine Corps bases on shore.

(b) First enlistments are for six years; subsequently, the periods are four years.

(c) After twenty years' service, enlisted men may be transferred to the Fleet Reserve and shall receive pay at the rate of fifty per cent of that received at the date of transfer.

(d) After thirty years' service men may be retired and thereafter receive seventy-five per cent of the pay received at the date of retirement, plus about \$16.00 per month allowances.

Should you desire further details, this Bureau will be glad to answer any specific questions.

Sincerely yours,

W. Henry Grant, D.M.D.,
406 Marlborough St.,
Boston, Mass.

A. KNOX,
Captain (DC), USN.

D:HGB

DEPARTMENT OF THE NAVY
BUREAU OF MEDICINE & SURGERY

Washington, D. C., June 13, 1941.

Dear Doctor Grant:

In reply to your letter of June 11, 1941, requesting information regarding the kind and amount of training dental technicians receive before being allowed to work in the mouth, please be advised that technicians (general) undergo a course of three months and technicians (prosthetic) undergo a course of five months.

Lectures, recitations, demonstrations, practice on manikins, and supervised administration of prophylactic treatment comprise the kind of instruction provided for technicians (general).

Instruction in all the mechanical phases of denture, bridge, crown and inlay work is provided technicians (prosthetic), and in the latter part of the course, cases are carried through the various procedures to completion.

Graduates of these courses are not considered to have more than a working knowledge of the procedures involved and work under the close supervision of dental officers at the various stations to which they are transferred. Naturally, as these men gain experience they become more expert and require less supervision, but they are at all times under the personal direction of dental officers.

Inasmuch as all technicians are pharmacist's mates or hospital apprentices, they are also instructed in and required to be proficient in general medical department duties and to pass examinations in subjects relating thereto, such as anatomy, minor surgery, first aid, materia medica, nursing, pharmacy and chemistry, in order to qualify for promotion.

Incidentally, candidates for admission to the above ratings are obliged to have completed two years of high school.

Sincerely yours,

W. Henry Grant, D.M.D.,
406 Marlborough St.,
Boston, Mass.A. KNOX,
Captain (DC), USN.

Comment: A question arises as to the complications which may come from allowing dental technicians to render, under supervision, dental prophylactic treatment. Such service is obviously beyond the scope of both the training and the duties of a dental technician. In fact, such treatment of tissues in the human mouth is specifically reserved by law for dentists and dental hygienists who have been examined by the State Board of Dental Examiners and licensed by the state. Such disregard for the legal aspects of dental practice may

easily lead to illegal practice of dentistry by ex-service dental technicians after they have been discharged from naval service. Records are available of such illegal practice of dentistry in the State of North Carolina by ex-service dental technicians formerly associated with the Dental Corps of the Army.

3. DENTAL LABORATORIES IN ILLINOIS PROHIBITED FROM ADVERTISING TO AND WORKING FOR THE PUBLIC DIRECTLY.

The following is Bulletin No. 6 of the Committee on Dental Legislation of the American Dental Association of which Dr. A. B. Patterson is the chairman. This bulletin is self-explanatory and shows what can be done to protect the public from fraudulent advertising and the illicit practice of dentistry by dental laboratories, providing the dental profession cooperates with the legal authorities in curbing such abuses:

"The Supreme Court of Illinois on June 13, 1941, rendered the following important decision. We believe that everyone interested in dental law and legislation will be interested in reading this Supreme Court opinion, particularly in those states where dental laboratories have been conducting similar advertising and where laws similar to the Illinois law have been enacted.

"The question involved was whether the 1939 amendment to the Illinois Dental Practice Act is constitutional. This amendment prohibits dental laboratories from advertising directly to the public or accepting orders for dentures from anyone except licensed dentists.

"The advertising laboratories in Illinois have ignored the law ever since it was enacted in the hope that it would be declared unconstitutional. This Supreme Court decision, however, will force them to cease advertising or become subject to severe penalties. The attorneys for the laboratories have requested the court to grant a rehearing on the case. The court has not to this date rendered opinion on this request, but it appears unlikely that a rehearing will be permitted.

"Docket No. 25989—Agenda 17—December, 1940.

"Edward N. Lasdon et al. v. John J. Hallihan, Director of Registration and Education et al., Appellees.—(Donald B. Alexander et al., Appellants.)

"Mr. JUSTICE MURPHY delivered the opinion of the court:

"This case comes direct to this court by appeal from a decree of the circuit court of Cook county, pursuant to leave granted appellants to appeal within one year under the procedure provided for in rule No. 29, 370 Ill. 29. Constitutional questions are presented which confer jurisdiction for a direct appeal.

"Seven persons, four of whom are appellants, instituted this action against the Director of Registration and Education, the Attorney General and the State's attorney of Cook County, seeking by such proceeding to enjoin such officials from enforcing by original prosecution, certain provisions of the Dental Practice Act which they claim violate the State and Federal constitutions. After evidence had been taken before the master and hearing was had on his report, the chancellor dismissed the complaint for want of equity. Appellants operated dental laboratories in Chicago for the making of prosthetic dentures, bridges and other substitutes for natural teeth.

"The constitutional attack is upon parts of section 5 of the Dental Practice Act as amended in 1939. (Ill. Rev. Stat. 1939, Chap. 91, par. 60.) The pertinent provisions of the section, as amended, are: 'A person practices dentistry within the meaning of this act: * * * (9) Who furnishes, supplies, constructs, reproduces or repairs or offers to furnish, supply, construct, reproduce or repair prosthetic dentures (sometimes known as "plates"), bridges or other substitutes for natural teeth to the user or prospective user thereof.'

" 'The following practices, acts and operations, however, are exempt from the operation of this act: * * * (f) The making and repairing of prosthetic dentures, bridges, artificial restorations or other structures to be used or worn as substitutes for natural teeth, or appliances for the correction of disease, loss, deformity, malposition, dislocation, fracture of or injury to the jaws, teeth, lips, gums, cheeks, palate or associated tissues or parts upon order or prescription given by a licensed and registered dentist and constructed on, or by use of, casts or models made from impressions taken by a licensed and registered dentist; provided that such prosthetic or orthodontic appliances, or the services rendered in the construction, repair or alteration thereof shall not be offered for sale, or use or delivery to the public. And provided further that such prosthetic or orthodontic appliances shall not be placed or adjusted in the oral cavity except by licensed and registered dentists.'

"It will be observed that under these provisions dental plates may, under certain specified conditions, be made by one who is not a licensed and registered dentist. Such conditions are (a) the impression from which the plate is to be made must be taken by a licensed dentist; (b) the persons engaged in the making of such appliances shall not offer to sell them or the services rendered in the construction of them to the public and (c) the placing and adjustment of the plates in the oral cavity shall be performed by a licensed dentist.

"The master found that for several years there had been two classes of dental laboratories in Chicago, those who dealt exclusively with licensed den-

tists having no contact or dealings with the general public or the patient for whom the plate was being made and those who advertised their business by offering to sell full or partial dentures to the public.

"The laboratories of appellants were within the latter classification. The pleadings raised an issue of fact as to appellants' method of transacting business. The finding of the master on that point is not questioned, the material parts of which are: 'The laboratories in question conduct their business in the following manner: an "ad" is placed in a newspaper of general circulation or some other publication offering for sale to the public full or partial dentures; a person in need of a full or partial denture who has seen the advertisement * * * enters the store or office of the laboratory and informs the plaintiffs or one of their employees that he wishes to purchase a denture; * * * The customer is asked * * * whether he, the customer, has a dentist; if he has not, the laboratory owner then recommends a dentist to the customer: the customer then leaves the laboratory and visits the dentist: the dentist makes an impression and arrangements are made between the customer and the dentist for the payment to the dentist for his services; * * * upon this impression, the one made by the dentist, the laboratory constructs the denture, which denture is then delivered to the dentist for fitting in the customer's mouth; the denture is then sent back to the laboratory by the dentist for adjustments and when it is finally completed, it is returned by the laboratory to the dentist for final fitting in the customer's mouth; the customer pays the laboratory for its work and pays the dentist for his work.' The appellants had each been engaged in the making of dentures for several years and previous to a few months before the trial their dealings had been exclusively with licensed dentists.

"Appellants say they do not contend that the provision of the act which requires the making of the impression and fitting and adjustment of the plate in the oral cavity to be done by a licensed dentist is not a proper exercise of legislative power, but that their objection is to the provision which prohibits them from making and offering dental plates for sale or use to the public.

"The specific reasons why the Federal and State constitutions are claimed to have been violated by the amendment to section 5 are (a) that the amendment unreasonably restrains trade, impairs the right of contract and deprives appellants of liberty and property without due process of law in violation of sections 1 and 2 of article 2 of the Illinois constitution and the fifth and fourteenth amendments of the Federal constitution; (b) that it violates section 13 of article 4 of the Illinois constitution in that the amendment purports to cover subjects not embraced in the title of the act and embraces more than one subject; (c) that it is special or class legislation, violating section

22 of article 4 of the State constitution and the fourteenth amendment of the Federal constitution; (d) that it is unreasonable, arbitrary, bears no relation to public health, morals or welfare of the people and is not a valid exercise of the police power, and finally, it is argued, as a matter of statutory construction that the dental laboratory operations as carried on by appellants did not constitute the practice of dentistry within the meaning of the act.

"Appellants are in no position to complain of the impairment of their right to contract as to matters relating to their business if their business was of such nature as to be the subject of legislative regulation through the exercise of the police power of the State. (*Semler v. Oregon State Board of Dental Examiners*, 294 U. S. 608, 79 L. Ed. 1086; *Rast v. Van Deman and Lewis Co.*, 240 id. 342, 60 L. Ed. 679; *Schiller Piano Co. v. Illinois Northern Utilities Co.*, 288 Ill. 580.) In discussing the extent of power which the legislature possesses in matters relating to the police power this court in *People v. Weiner*, 271 Ill. 74, said: 'The power of the legislature to pass laws for the preservation of good order or to promote public welfare and safety, or to prevent fraud, deceit, cheating and imposition, has always been recognized in this State. (*People v. Freeman*, 242 Ill. 373; *People v. Schenck*, 257 id. 384.) * * * A rightful exercise of the police power is not a violation of the fourteenth amendment even though property interests are affected. * * * The police power has been defined as that inherent and plenary power in the state which enables it to prohibit all things hurtful to the comfort, safety and welfare of society. * * * This power is very broad and far-reaching, yet it is not without its restrictions. While the courts will not pass upon the wisdom of an act concerning the exercise of the police power, they will pass upon the question of whether such act has a substantial relation to the police power. * * * It must have some relation and be adapted to the ends sought to be accomplished.'

"In the exercise of police power the practice of the professions has been subjected to licensing and regulation for the reason that the services customarily rendered by those engaged in such professions are so closely related to the public health, welfare and general good of the people, that regulation is deemed necessary to protect such interests. It has been held a proper exercise of police power to legislate and protect the professions performing such services against commercialization and exploitation. (*Winberry v. Hallihan*, 361 Ill. 121; *Semler v. Oregon State Board of Dental Examiners*, *supra*; *People v. Peoples Stock Yards State Bank*, 344 Ill. 462.) In the *Semler case*, *supra*, in discussing the objectives sought by the legislature of the State of Oregon in enacting the Dental Practice Act of that State, the court said: 'The legislature was not dealing with traders in commodities but with the

vital interest of public health, and with a profession treating bodily ills and demanding different standards of conduct from those which are traditional in the competition of the market place. The community is concerned with the maintenance of professional standards which will insure not only competency in individual practitioners but protection against those who would prey upon a public peculiarly susceptible to imposition through alluring promises of physical relief. And the community is concerned in providing safeguards not only against deception, but against practices which would tend to demoralize the profession by forcing its members into unseemly rivalry which would enlarge the opportunities of the least scrupulous.'

"In *Winberry v. Hallihan*, *supra*, in considering the power of the legislature to regulate dental advertising by licensed dentists as provided in sections 18 and 18b of the act, the reasoning in the *Semler case* was followed and it was held the sections of the act regulating advertisements by licensed dentists were valid. Since it is established by precedent that the legislature may, in the exercise of the police power, regulate advertisement by licensed dentists for the purpose of protecting the profession against commercialized exploitation, it would follow that if section 5 can be considered as having been enacted for the same purpose, it should be sustained on such precedent.

"The facts as found by the master may not fully justify a statement that appellants designed to commercialize and exploit the profession of dentistry, but there is sufficient in the record to warrant the conclusion that if the objectionable provisions of the act were removed on constitutional grounds the possibility of commercialized exploitation of the profession would be present.

"Appellants claim they have a constitutional right to advertise their business and sell their products to the public, subject only that the making of the impressions and the fitting and adjustment of the plates shall be by a licensed dentist. It is obvious that if they were permitted to thus advertise their business, the practice of the profession of dentistry would, to a great degree, be subservient to the business of those engaged in the making of plates. It is well known that the masses of the public do not comprehend or understand the skill that is necessary to the making of proper dentures and the proper charges to be made for such services. Such persons are often attracted by the advertisements of the quack and charlatan and seek his services.

"Appellants concede that a considerable number of their customers come to their laboratories because of the advertisements and publicity they give to their business. They also admit that they refer many of their customers to a dentist, as a rule to one particular dentist. Dr. Hejna testified that about thirty-five per cent of his patients were referred to him by ones operating a laboratory. If the advertisement carried on by the dental laboratories was the medium that brought the customer to the laboratory, and he was sent

from there to Dr. Hejna's office, it would, as to its effect upon the dental profession, be much the same as though he had come to Dr. Hejna's office in answer to an advertisement of Dr. Hejna's, which is prohibited by sections 18 and 18b of the act. If the restrictions of which appellants complain were removed, it would permit licensed dentists receiving patients referred to them by the dental laboratories to do indirectly what other provisions of the act prohibit them from doing directly.

"The right to follow the professions is one of the fundamental rights of citizenship. A person's business, profession or occupation is property within the meaning of the constitutional provision as to due process of law and is also included in the right to liberty and the pursuit of happiness. (*People v. Love*, 298 Ill. 304.) The right to pursue a lawful calling, business or profession cannot be arbitrarily taken away but where, as in this case, the legislature has the right to regulate the profession by the protection of society there is no loss of property or violation of the right to liberty and the pursuit of happiness. (*People v. Walsh*, 346 Ill. 52.)

"It is next contended that the part of section 5, as amended, which defines the practice of dentistry to include the making of dental plates violates section 13 of article 4 of the State constitution by introducing into the act another subject and one which was not included in the title to the original act. The title of the act in 'An act to regulate the practice of dental surgery and dentistry in the State of Illinois.'

"The subject of 'an act' as that term is used in the constitution, means the matter or thing forming the groundwork of the act, and may include many provisions that are germane to it and are such that, if traced back, will lead the mind to the subject as the generic head. (*Perkins v. County Comrs.*, 271 Ill. 449; *People v. Solmon*, 265 id. 28.) Any matter or thing which may reasonably be said to be subservient to the general subject or purpose will be considered germane and may be properly included in the law. (*Mannina v. Alexander Auto Service Co.*, 333 Ill. 158; *People v. Kramer*, 328 id. 512; *People v. Sargent*, 254 id. 514.)

"Unless an act contains matters which are not germane to the title or the title expresses subjects without any proper relation to each other, the constitutional provision is not violated. The General Assembly must determine the comprehensiveness of the subject of an act and the particularity of the act defining the subject. An act having a single general subject expressed in the title may contain many provisions however diverse, if they are not inconsistent with or foreign to the subject. (*Department of Public Works v. Spanogle*, 327 Ill. 122; *People v. Stacker*, 322 id. 232.) The tendency is to construe this constitutional provision liberally and not strictly, for the latter course would embarrass legislation and largely defeat the beneficial purposes for

which the provision was adopted. (Cooley's Const. Lim. [7th ed.], p. 209.)

"The subject of the Dental Practice Act includes within its terms the regulation of the practice of dentistry and, as previously stated, the purpose of the provisions of section 5 is to protect and regulate the practice of that profession. The provisions objected to bring within the purview of the act matters which are germane to the title. The act is not subject to the constitutional objection made.

"Another constitutional objection urged against section 5 is that it is special legislation and violates the clause of section 22 of article 4 of the State constitution, which provides: 'The General Assembly shall not pass local or special laws granting to any corporation, association or individual any special or exclusive privilege, immunity or franchise whatever,' and that it violates the fourteenth amendment of the Federal constitution.

"It is claimed that since the dental laboratories were found to be of two classes, namely, those which deal exclusively with dentists and those which advertise and sell to the public, and that section 5 being directed against the latter class, an unjust discrimination is created between the two classes of laboratories.

"This section does not divide those who operate dental laboratories into two classes. It merely provides that the making of dental plates under certain conditions is not included within the provisions of the act. There is no statutory provision prohibiting any one engaged in such business from complying with such conditions. Compliance carries with it the right to be exempted from the provisions of the act. A law is not local or special in a constitutional sense if it operates in the same manner on all persons in like circumstances. (*Springfield Gas Co. v. City of Springfield*, 292 Ill. 236.) General laws are those which relate to or bind all within the jurisdiction of the law-making power. If a law is general and uniform in its operation upon all persons in like circumstances, it is general in a constitutional sense, but it must operate equally and uniformly upon all brought within the relation and circumstances for which it provides. (*Lippman v. People*, 175 Ill. 101.) The act does not confer exclusive privileges and does not violate these constitutional provisions. The right to the equal protection of the laws guaranteed by the fourteenth amendment is not denied when it is apparent that the same law or course of business is applicable to any person in the State under similar circumstances and conditions. (*Linsley v. Anderson*, 171 U. S. 101, 43 L. Ed. 91.)

"The objection that the restrictions imposed by section 5 have no relation to public health and the general welfare has been fully covered in the disposition of the previous questions in this case and by what was said in *Winberry v. Hallihan*, *supra*.

"Appellants' final contention that section 5, as amended, even though constitutional, does not prohibit the dental laboratory operations performed by appellants has been disposed of by what has already been said. Appellants cite *Winner v. Kadow*, 375 Ill. 192, in support of such contention. The facts as recited in the opinion of that case show that the plaintiff who made the plate complied with the provisions of section 5. The impression was made and the plate was fitted by a licensed dentist and there was no evidence that the plaintiff had held himself out as selling dental plates to the public. The distinction which is made in this case between the operations of the two different classes of dental laboratories was recognized in the *Winner case*. Appellants were not entitled to injunctive relief and the decree was correct.

"The decree of the circuit court of Cook county was right, and is affirmed.
"Decree affirmed."

4. DENTAL TECHNICIANS IN THE STATE OF WASHINGTON SEEK
LICENSE TO PRACTICE PROSTHODONTIA

After many unsuccessful attempts on the part of dental technicians in other states to be licensed as dental technicians, master technicians, etc., the dental technicians of the State of Washington sponsored the following Senate Bill No. 175, which if enacted into law would permit the licensure of technicians as prosthodontists with the right to practice denture prosthesis under the direct supervision of licensed dentists.

In the Senate

By Senator Thomas

SENATE BILL NO. 175

STATE OF WASHINGTON, TWENTY-SEVENTH REGULAR SESSION

February 6, 1941, read first and second time, ordered printed, and referred to Committee on Medicine, Dentistry, Pure Foods and Drugs.

AN ACT

Relating to the practice of prosthodontia; providing for the filing of applications, examination and licensing of prosthodontists engaged and engaging in the taking of impressions and making recordings of edentulous or partially edentulous mouths for the purpose of supplying removable artificial dental restorations; fixing amount of license fees, providing for license renewals; defining terms and offenses and fixing penalties; prescribing the power of certain public officials and officers; saving certain acts and repealing all acts and parts of acts in conflict herewith.

Be it enacted by the Legislature of the State of Washington:

SECTION 1. No person, other than a licensed dentist, shall practice as

a prosthodontist in this state without having applied for and received a license, and yearly thereafter an unexpired license renewal certificate.

SEC. 2. Any person having obtained a license as a prosthodontist in this state may take impressions, bites, examine, give advice, and make recordings of edentulous or partially edentulous mouths, but shall not perform, examine or advise any other operation on the teeth, mouth or tissues of the oral cavity: PROVIDED, That such work is done only for the sole purpose of supplying removable artificial restorations: PROVIDED FURTHER, That such work is done only under the direct supervision of a licensed dentist, and that the number of prosthodontists shall not exceed the number of licensed dentists practicing in any one establishment.

SEC. 3. Any citizen of this state who is of good moral character, of legal age, and can furnish proof of ten (10) years' practical experience within this state as a dental technician (all time spent in any recognized dental college shall be considered as practical experience) may file his application for a license as a prosthodontist in the manner provided by law and on forms furnished by the director of licenses. Said application shall be signed and sworn to by the applicant. Each applicant shall pay a fee of fifteen dollars (\$15) which shall accompany his application.

SEC. 4. Examination of applicants for prosthodontist licenses shall be by the Washington State Dental Board, and shall be of such character as to thoroughly test the competency of the applicant and shall consist of both written and practical tests, including the subjects of impression taking, bite recording, esthetics, mechanics, articulation and kindred subjects contained in the curriculum of mechanical dentistry. Said written examination shall consist of ten (10) questions only on each subject, graded from zero to ten, and applicant must obtain an average grade of sixty five per cent (65%) to pass. Said practical examination shall consist of a clinical demonstration of impression taking, bite taking, trial and delivery of one or more prosthetic restorations, and the applicant must obtain an average grade of seventy five per cent (75%) to pass. The director of licenses shall keep on file the examination papers and complete records of the examination for at least one year, and said papers and records shall be open for inspection to the applicant or his agent.

SEC. 5. Upon passing of the examination as provided in section 4 of this act, the director of licenses shall issue to the successful applicant a license as a prosthodontist. Said license shall be recorded with the county auditor of the county in which the licensee shall practice, and said license shall be displayed in a conspicuous place in the operation room where the licensee shall practice.

SEC. 6. Each person licensed as a prosthodontist must pay, on or before

the first day of October of each year, a license renewal fee of one dollar and fifty cents (\$1.50), for which the director of licenses shall issue a license renewal certificate. Said license renewal certificate shall be displayed together with the license of said licensee.

SEC. 7. Any person, other than a licensed dentist, who shall practice, attempt to practice, or hold himself out as practicing, prosthodontia without a valid and unrevoked license, and, after the first year, a valid and unexpired license renewal certificate as provided in this act, shall be guilty of a misdemeanor. Any licensed prosthodontist who shall violate any of the provisions of this act shall be guilty of a misdemeanor and shall be liable to a fine or suspension of his license for a period of one year, or to both such fine and suspension.

SEC. 8. Any licensed dentist who shall permit any prosthodontist operating under his supervision to perform any dental operation other than that provided for within this act shall be guilty of a misdemeanor.

SEC. 9. Any person who shall violate any provision of this act shall be guilty of a misdemeanor, and each violation shall be deemed a separate offense. It shall be the duty of the prosecuting attorney of each county to prosecute all cases of violation of this act arising within his county.

SEC. 10. Words used in this act imparting the singular number may also be applied to the plural of persons and things; words imparting the plural may also be applied to the singular; and words imparting the masculine gender may be extended to females also.

SEC. 11. If any section, subsection, clause, sentence or phrase of this act is for any reason held to be unconstitutional or invalid, such decision shall not affect the validity of the remaining portions of this act.

SEC. 12. All acts and parts of acts in conflict herewith are hereby repealed.

The dental profession of the State of Washington is aware of the potential threat to the unity of dentistry which this bill contains, and may be expected to prevent its passage in the Senate.

5. UNIONIZATION OF DENTAL TECHNICIANS

A. P. O'HARE, D.D.S.

The present trend toward unionization of dental technicians by the American Federation of Labor raises the question as to what effect such organization may have on oral health service, which the dental profession renders to the public. The following is a summary of laboratory prosthetic service to the profession with unionized dental technicians.

Advantages: Enlightened moral and legal opinion grants to men in all crafts the right to organize—This concept has been written into the law of the land and therefore, we feel is not subject to review in this report; however, we might point out in passing that laboratory fees can more easily be equitably stabilized where the employees are organized than where labor is in the position of competing with itself, the sequellae which often follow are price cutting, rebates, discounts, etc.

I believe that it is axiomatic that men intelligent enough to organize usually are better craftsmen and produce better work; this seems to be true in the profession and although we are organized on different lines and with different concepts, I believe we have no right to deny to the dental technicians a right we insist is ours.

In fairness it must likewise be remembered that the dental technicians did not thrust themselves upon the profession, but were introduced into a phase of prosthetic dentistry by the dentist, the reasons for which are quite obvious.

Disadvantages: Fee schedules for laboratory service would be expected to rise; this might not prove to be a bad thing in itself, the question would resolve itself around ethics and fairness.

Controversies might arise between laboratory proprietors and craftsmen resulting in stoppage of work, which in turn could be embarrassing both to dentist and patients. The apprentice problem could, if arbitrarily dealt with, prove a serious thing.

Potential Dangers to Profession and Public: A source of great danger to the profession and the public could only come if the organization of the dental craftsmen's union lacked democratic rule within itself—if the men allowed their union to become dominated by racketeering individuals bent upon confusion. This writer has an abiding faith in the man who works and believes that barring the above subversive element he may be depended upon to do the right thing.

I believe the dental profession would be doing itself a great disservice if it placed itself in the position of trying to prevent the dental technicians from organizing themselves as they choose, cer-

tainly we should not, in my opinion, try to foster a profession dominated union under any guise whatsoever.

This report is, in the final analysis, merely one man's views and necessarily is not conclusive—It is based on meager questioning and limited observation. This awareness has caused me to formulate three questionnaires which are attached hereto, with the suggestion that they might form a basis for the collection of data from various parts of the country, a study of which might prove useful.

A further discussion of unionization of dental technicians is contained in the following report to the Wisconsin State Dental Society by the Prosthetic Service Committee, of which Dr. Nelson, a member of this committee, is chairman:⁴

"At the first meeting of the dental technicians called for February 7, 1941, by J. F. Frieduch, General Organizer, Federal Trades Council of Milwaukee, according to his statement, a great deal of interest was shown among the technicians for the foundation of a local union of dental technicians to be affiliated with the American Federation of Labor.

"They state the number attending this meeting exceeded their expectation and they were also gratified by the interest shown by the men in the participation on the subject of organization.

"It has come to their attention that one of the dental laboratories in Milwaukee was seeking to put obstacles in the way of organization, but they were sure that if the majority of the technicians in the city wanted to join a labor organization they could remove any obstacle that any company could put in their way.

"At a meeting on February 25, 1941, the dental technicians interested in the foundation of a local union affiliated with the American Federation of Labor voted to apply for a charter to the American Federation of Labor for such a union. Temporary officers and a committee were appointed to go from house to house to solicit new members.

"At their meeting of March 7 they hoped to have a charter and supplies from the American Federation of Labor. Monthly dues are \$1.00—Initiation fees \$2.00. They had a complete list of the technicians, hygienists, and an incomplete list of the dental assistants. The most important development at this meeting was the following:

"THAT AS THE DENTAL ASSISTANTS IN THE DENTAL OFFICES AND THE HYGIENISTS COULD DO A PART OF THE PROSTHETIC WORK, THEY, NATURALLY, WOULD COME UNDER THE SUPERVISION OF THE TECHNICIANS

⁴Nelson, C. A., Personal Communication.

UNION AND, THEREFORE, A DRIVE SHOULD BE STARTED TO INCLUDE ALL SUCH HYGIENISTS AND ASSISTANTS WHO DO ANY PART OF THE LABORATORY WORK IN THE DENTIST'S OWN LABORATORY.

[At this meeting it was proposed to start immediate unionization of technicians outside of the city of Milwaukee.]

"On February 6, it was reported sixty-eight dental technicians in Milwaukee had signed up. The following demands are to be made:

1. All technicians will be classified and a demand made for increases in salaries as to their classifications.
2. The minimum salary for any laboratory man would be \$25.00 a week, whether he does plaster work or any other type of work in the industry.
3. A 40-hour week.
4. Saturday closing.
5. Time and one-half for overtime.
6. Licensing of all dental technicians.
7. Two weeks' vacation with pay.
8. The eventual inclusion of hygienists and dental assistants. Organization efforts in this respect, as I understand it, will be under way within the next few weeks.
9. Rules and regulations set up for the relationship between the laboratory man and the dentists.
10. A demand by the unions that prices be raised.
11. A closed shop.

"On March 3, 1941, a conference was held by the President of a Milwaukee Commercial Dental Laboratory opposed to unionization of the technicians—The A.F.L. organizer and the Technicians' Union President. The result of this meeting: the organization efforts would continue; their committee contemplated a conference with the executive council of the Wisconsin State Dental Society; and a conference with the Associated Dental Laboratory of Wisconsin.

[On March 4, 1941, a secret ballot was held among all the employees of one Milwaukee laboratory on the union question. By unanimous vote in secret ballot of all technicians employed in that laboratory, it was obvious that all the technicians voted against joining the union. Four technicians who had already joined, tendered their resignations. Their statements were signed and witnessed.]

"On March 7, 1941, the meeting of the Technicians' Union was poorly attended. The organizer for the A.F.L., however, outlined further activities and urged dental technicians to continue their organization efforts.

"The laboratory owners are much disturbed over this movement and are calling and begging for our help. They fear it will throw the industry into chaos, and that it will lead to regimentation, not only of the industry, but also

of the profession, through unionization of the hygienist and the dental assistant. The industry knows that we, by our training, can do our own laboratory work or send it outside the state for processing.

"Dentistry has been declared a profession and not a trade, by the United States Supreme Court when it upheld the Oregon law. We may refer to that decision because in dealing with union methods of conduct the following would cover a common ground:

'The legislation was not dealing with trades in commodities, but with the vital interest of public health, and with a profession treating bodily ills and demanding different standards of conduct from those which are traditional in the competition of the market place.'

"Not only is our conduct guided by our dental practice act, but also by our Code of Ethics. We have developed the dental technician as a valuable adjunct to our profession. The dental technician belongs to a trade that has professional relations. Public health and welfare would not and should not tolerate union practices. Life and good health cannot wait on strikes, walk-outs, and sit downs. As a profession we do not think in terms of a forty-hour week, two weeks' vacation with pay, time and a half for overtime, minimum wages and Saturday closing. We stand and wait to serve at all times either night or day.

"Dentistry and the public will not approve unionization of the dental technicians. The profession is trained in all laboratory procedures and can do their own laboratory work. Laboratory owners fear unionization because it would drive work to other states. That would happen. Cooperative dental laboratories conducted by the State or component societies had been suggested. Boycott of union laboratories would follow.

"The dental technician is an important adjunct to our profession. His continued restlessness seems to demand some sort of a place in dental society. We again recommend a professional-technician relations committee that would organize the technicians into study groups, clubs or societies, with proper objectives and Codes of Ethics in conformity with our professional standards."

Respectfully submitted,

A. R. Dippel,

A. O. Torson,

C. A. Nelson, Chairman,

Prosthetic Dental Service Committee,

Wisconsin State Dental Association.

6. PENNSYLVANIA DENTAL COUNCIL AND EXAMINING BOARD DIS-
APPROVE THE USE OF DENTAL TECHNICIANS IN OR BY DENTAL
SCHOOLS.

At a meeting of the Dental Council and Examining Board held in Harrisburg on August 3, 4 and 5, 1941, the following motion was unanimously adopted:

The Dental Council and Examining Board of the Commonwealth of Pennsylvania does not approve of dental schools engaging technicians or permitting dental students to engage technicians to perform any practical or technical work assigned to them for credit leading to a degree. This applies to work performed in the dental school or outside of the dental school.

This action of the Pennsylvania Dental Council and Examining Board opens the way for a discussion of the complications arising from the use of dental technicians in any capacity in the present dental educational program.

Dental technicians, while regarded as adjuncts by the dental profession, insist that they are an industry and, in some states, have allied themselves with trade unions. The unionization of technicians, together with the fact that they are neither formally trained in dental schools nor licensed by the state, raises the question as to whether or not the use of technicians by dental schools is in keeping with the present standards of dental education and consistent with the exacting requirements for students of dentistry. From the scholastic point of view, it is inconsistent to delegate to unschooled and unlicensed dental technicians those technical procedures which a student must learn in course and on which he must be examined by the State Examining Board before he can become a licensed practitioner. The use of technicians causes the student to doubt the necessity for all the prosthetic technic work he was required to do during the preclinical years and tends to discredit, in the student's mind, the concept of prosthetic dentistry as an oral health service. It further deprives him of the experience, the practice, and the responsibility of carrying-through, from beginning to end, all the procedures involved in actually serving prosthetic patients in the school clinic. If a student's training in laboratory procedures is to end with his preclinical prosthetic technic work, his ability and interest in his work

will be greatly limited. The serving of patients in the clinic adds new interest to, and a desire to excel in those laboratory procedures which in the preclinical years, to him, may have been uninteresting and sometimes drudgery, because of the absence of that motivation which comes from serving patients. During the junior and senior years, students try to become proficient in the laboratory procedures so that they may render an increasingly higher grade of oral health service in the clinic. By the time of graduation, the student has acquired the skill and experience that will qualify him to do the laboratory procedures himself, or, if he desires, to delegate certain procedures to the laboratory technician with instructions as to how the work shall be done. Further, his experience with the exacting requirements of each laboratory procedure enables him to judge the quality of work received from the technician and, if it is not satisfactory, to make suggestions to the technician which will lead to the desired improvement in his service to the dentist.

The argument has been advanced that dental students learn to cooperate with the dental laboratory, when a technician is employed by the school. Certainly, the student who depends on a technician to do his laboratory work while in school, will be at the mercy of dental technicians after he graduates. Unfortunately, this is not cooperation, nor can it lead to satisfactory cooperation, unless the dentist is fully qualified to judge the standards of laboratory work. In some schools where technicians are employed, the student has no relations with the technician such as would exist in practice. The technician is instructed to do the laboratory procedures exactly as the head of the department wants them done. The student likewise is trained to prepare his work in a definite manner so that it is ready for the technician. The student turns in his case and sees nothing more of it, until it has been completed. He need not be at all concerned about it, since the school is responsible for having the laboratory work done by its own technician and in the manner prescribed by the school.

In practice, however, the situation is entirely different. The technician is neither trained nor controlled by a dental school. He may know little or nothing of the procedures which the recent graduate

expects him to know. He may be poorly trained and incompetent. Lastly, there may be no technician, if the dentist locates in a small town. Under these handicaps, the young dentist must decide either to take what he can get from technicians, or to do his own laboratory work. Having been taught to rely on the dental technician while in school, the dentist now finds himself technically and psychologically unprepared to do his own laboratory procedures. Therefore, he takes what he can get from available laboratory technicians, or sets to work, at a great inconvenience, to master the technical steps which he should have acquired while in the dental school.

The employment of dental technicians by dental schools is the highest compliment that can be paid to the technicians and the strongest recommendation for the patronage of dental laboratories. Employment of technicians by dental schools, implies, as technicians have repeatedly said, that they know more about the laboratory procedures than do the dentists, consequently, dental teachers must employ technicians to learn how to do modern laboratory work. This self-esteem on the part of technicians is discounted by dentists who know the truth through experience with dental laboratories. Nevertheless, the use of technicians in dental schools gives the highest sanction to the patronage of dental laboratories by the profession, even though many laboratories are not worthy of that patronage. Such patronage, as has been pointed out by this committee in former reports, tends to degrade the quality of prosthetic oral health service to the public and to make a separate specialty of the laboratory procedures which, in the hands of technicians, presents a potential threat to the unity of dental practice in the future.

The question arises as to the real reason for the employment of dental technicians in the dental school. There is a feeling among dental administrators that technicians so employed are used for two purposes, to reduce the overhead and to increase the income from the school clinic. Reduction of overhead is accomplished by the employment of technicians at wages lower than those paid to dental teachers ordinarily required to supervise the clinical laboratory work. Infirmary income may be increased by having the students devote their time to the work at the chair. In this manner, each student

may take care of more denture patients during his clinical years in the school which in turn increase the income from the clinic. When the clinic is operated according to the recommendation of the curriculum survey report of the American Association of Dental Schools, the income from the clinic would not be increased. However, as will be mentioned later, some school clinics are not conducted according to those recommendations.

The argument has been advanced that the use of dental technicians in the school enables dental students to observe a greater variety of prosthetic restorations than would be possible if the student were required to do the laboratory work himself. When subject to analysis, it will be found that the laboratory procedures involved in flaking, packing, curing and finishing complete upper and lower dentures require approximately one-fifth of the total time consumed in making such a restoration.

In the average dental school a student completes a total of approximately ten to twelve single dentures during his clinical years and the use of a dental technician would increase his production approximately one-fifth, permitting him to make two additional dentures during the time allotted to his work in the prosthetic department. It is unreasonable to assume that the making of an additional upper and lower restoration would add sufficient variety to the student's experience to justify the employment of technicians in the school.

Contrary to the letter and the spirit of the recommendations of the Curriculum Survey Committee of the American Association of Dental Schools, there are dental schools which require students to make between twenty and forty dentures during the clinical years. Such a heavy schedule in the department of prosthesis would, undoubtedly, necessitate the employment of technicians and deprive students of the training in other clinical subjects which are recommended in the survey and provided in a well-balanced clinical curriculum.

The difference in the income from the infirmary of a school requiring ten dentures and one requiring thirty dentures cannot be ignored. With a senior class of one hundred students, and enough

patients, that difference is approximately one thousand dentures a year.

The infirmary of a dental school is primarily a teaching clinic in which students receive instruction, practice and experience in rendering an oral health service to patients. In such a teaching institution, patients are necessary primarily for the contribution they make toward the student's education by providing the need for the oral health service which dental students can render. Unfortunately, through lack of endowment, the school must receive a nominal fee for the service rendered. Such fees, while ordinarily small, may open the way for commercial exploitation, especially when dental technicians are used, by increasing the number of patients to the point where mass production of dental appliances interferes with the primary objective in dental education, namely, sound education of students. A university supervised dental school which resorts to mass production in its clinic at the expense of the student's education is just as undesirable as those proprietary dental schools which have been discredited and disapproved by the Dental Educational Council and by all right thinking practicing dentists and dental teachers.

When the schedule of one clinical department takes the student's time which, in a well-balanced curriculum, should be given to work or study in another department, overloading results and the student is deprived of essential training which may handicap him after graduation.

In protecting the future interests of the public, of dental students, and of the dental profession, the Pennsylvania Dental Council and Examining Board has disapproved the use of dental technicians by dental schools which, to this committee, presents a potential source (1) of mass production and exploitation in dental schools, (2) of inferior prosthetic oral health service to the public by dentists who are at the mercy of dental technicians, and (3) of a threat to the unity of dental practice as shown by the recent bill which, if enacted into law, would make "prosthodontists" out of dental technicians in the State of Washington.

7. CONSULTANTS

During the past summer, thirty-seven consultants, Fellows of the College, were added to the personnel of this committee. A letter asking cooperation and containing the following questions was sent to each one.

1. How can the most satisfactory profession-laboratory relationship be attained? Indicate which of the following suggestions appears most logical to you:

- (a) By joint conferences between this committee and laboratories?
- (b) By joint conferences between a committee of the American Dental Association and laboratory leaders?
- (c) By encouraging and assisting committees of state and component dental societies to confer with laboratory groups in formulating mutually helpful agreements based on their own needs and experience?
- (d) By some other plan suggested by you.

2. What subjects, not already considered, should be studied by the Committee on Dental Prosthetic Service?

Ten replies were received, of which three favored joint conferences between this committee and the laboratories; one preferred joint conferences between a committee of the American Dental Association and the laboratory leaders; five approved conferences between committees of state and local dental societies and the laboratory groups; and one did not state a preference.

A list of suggestions by the consultants follows:

- 1. A study should be made of fees charged by dental laboratories for bridges made of gold or stainless white metals.
- 2. Registration of laboratories under state laws, and examination of technicians by State Board of Dental Examiners should be done.
- 3. Technic courses with laboratory men as assistants should be inaugurated.
- 4. The possibility of dental schools training all workers in the dental field, including hygienists, nurses, assistants and laboratory technicians should be studied.
- 5. Education of dentists as to their responsibility in dealing with laboratories should be carried out.
- 6. Dentists should be trained to cooperate with the laboratory.

These questions should receive the attention of this Committee in planning its work for the coming year.

IX. RELATIONS

J. O. GOODSSELL, D.D.S., *Chairman*¹
Saginaw, Mich.

Dentistry, during the past year, has received newer and greater attention from many sources. The startling revelation to the general public that a large proportion of our young men are unable to do military duty because of dental deficiencies and the appreciation of need for a correction of this situation, for reasons of health as well as warfare, have centered the spotlight upon us. Also, the possibility of a future shortage of dentists is coming to the attention of many who heretofore did not know or did not care. The implications clearly demand some sound thinking and planning on the part of the dental profession. If the problems are not solved by us we may be assured that someone will solve them for us and the repercussions might easily lead to alterations in present methods of practice. Perhaps some changes are needed, but dentistry should be awake and in the forefront if the pattern is to be cut. Patriotism and national defense may give us a "breather" but some day, we hope, the war will be over. Then we should be ready for any eventuality.

In view of the foregoing, if any portion is logical or true (and if for no other reason), it would seem that each and every dentist in the United States should be giving increased consideration to his own position as an influence in the moulding of public opinion toward dentistry. Each and every one of us is a member of the Relations Committee. Our individual behavior toward our patients, our community, society in general and ourselves earns respect or disrespect for our profession and our services. Our contacts with other groups if properly made and fostered are valuable. Your Relations Committee has attempted to make and foster contacts with those who can be of value to the public and to dentistry. It has given a little thought to methods for improving public appreciation of dentistry and of dentists. Obviously, its efforts do not produce much visible fruit but it has tried to be of some service.

¹The other members of this Committee are (1940-41): H. T. Hoffman, L. E. Kurth, T. E. Purcell, Nathan Sinai, Wilmer Souder, E. G. Van Valey.

The work of the Relations Committee has been divided, as in the past, so that each member is responsible for some phase of dental relations or for a special assignment. In addition, about fifty consultants to the Committee recently have been selected. They are among the leaders in all parts of the country and while they haven't been used a great deal, as yet, their presence on the Committee should contribute much to future achievement.

I. MILITARY AFFAIRS

Dentists are playing their parts in a fine way in the National Defense program. They serve on draft boards, appeal boards, etc. Their Military Affairs Committees are organized very efficiently in the American Dental Association and in most state and local societies. Those who are in the armed forces themselves have a great opportunity to spread the gospel among the enlisted men.

There is another opportunity which is not wholly dental but which exists for the War Department and Dentistry. The matter of army morale is one which concerns every citizen in the United States. We have been told that the German soldier is well satisfied with his lot because of the fact that he knows he is better taken care of in the army than he would be if he were at home. Of course, we cannot compete with the Germans on that basis because the average American soldier, no doubt, feels differently about his own home. However, we can create satisfaction in the mind of the soldier by impressing him with the fact that everyone is interested in his personal welfare. If it is true that only 20 per cent of the civilian population receive dental care the same average must hold for the army at the time of induction. Doesn't it seem likely that complete dental care for all soldiers would make them feel that at least in one respect they are better taken care of in the army than they would be at home? If so, the effect on army morale would be obvious.

The present military situation yields an opportunity in that the thing for which we have been looking, a cross-section of the dental needs of the population, is becoming readily available providing steps are taken to utilize it. Hundreds of thousands of examinations of draftees in the age group 21-35 are being made. It is absurd

to limit the examinations to the superficial information concerning whether a man has enough teeth to be accepted for army service. Here is an opportunity to set up an examination which, though relatively simple, may provide a cross-section of an age group that we have been unable to touch in the United States.

Recently we have been hearing of rehabilitation and, of course, since dental defects stand high in the list as a cause of rejection, one of the first concerns must be dental corrections. A plan, sponsored by organized dentistry and offered to the Federal Government whereby satisfactory corrections might be made would at least indicate our dissatisfaction with the present situation. Then, if rehabilitation becomes a reality the dental profession will guide it.

2. STATE AND LOCAL GOVERNMENT HEALTH PROGRAMS

Dental health programs in state, county and city health departments are fertile fields which can never be fully developed until organized dentistry takes a more active interest in them. The College could be a guiding influence, but the government agencies look to our official organizations for help and cooperation. Therefore we, as individuals, should assist our own dental societies in their efforts to make the work of our health departments more effective.

3. BOY SCOUTS, GIRL SCOUTS, CAMP FIRE GIRLS, NATIONAL EDUCATION ASSOCIATION, NATIONAL CONGRESS OF PARENTS AND TEACHERS, ETC.

Requests were made for information to the Boy Scouts of America, the Girl Scouts of America, the Camp Fire Girls, Health Physical Education and Recreation Department of the National Education Association, the Parent-Teacher Association (National), and 4-H Clubs (National).

No replies were received from the Parent-Teacher Association or the 4-H Clubs.

In the requests for information, particular stress was laid upon the deplorable dental conditions of our young people as revealed by the examinations for military service and the high percentage of rejections because of dental defects. It is evident from the replies received that, while there is a general interest and desire for

cooperation, nevertheless, dentistry is not receiving the consideration which its importance deserves.

Boy Scouts of America: I quote from the reply of William E. Lawrence, Assistant Director, Health and Safety Service, Boy Scouts of America:

"In our program emphasis is placed upon medical and dental examination and the correction of remediable defects. As I am sure you can recognize, we can ourselves give no dental examinations and our greatest contribution is in the field of general health education and the value of both medical and dental examination work.

"When a boy becomes a member of our movement we recommend that he have a complete medical examination and wherever possible dental examination, and parents are urged to bring about the correction of defects.

"Continuous attention is called to the importance of dental health in our Personal Health Merit Badge pamphlet, Physical Development Merit Badge pamphlet, the Handbook for Boys, and as the boy advances from one rank to another in scouting."

Girl Scouts of America: Margaret C. Lewis, M.D., Health and Safety Advisor Program Division, Girl Scouts, writes as follows regarding the program for dental health education and corrective dental service being conducted by that organization:

"While we have no program designed for that specific purpose we are working very actively toward that end as part of the general health program.

"Where corrective dentistry or any other remedial treatment is recommended a special effort to see that this is followed through is made. In this way we feel that we will make a definite contribution toward the corrective dental service. In addition we are making a study and program application of adequate nutrition a part of the program which is shared by all the girls. We realize that there is a direct relation between this and dental health."

Camp Fire Girls: C. Frances Loomis, Editor Department of Publications, Camp Fire Girls, writes:

"We shall be glad to cooperate with you in any way possible in furthering the formation of proper dental habits among our young people. I am sending you a copy of our 'Health Chart' which is designed to encourage the girls in good habits of health and personal grooming. In our 'Book of the Camp Fire Girls,' we have a chapter on 'Making the Most of Me,' and in that we point out the advisability of periodic dental examinations and systematic care of the teeth."

National Education Association: N. P. Neilson, Executive Secretary, American Association for Health, Physical Education and Recreation, National Education Association, writes:

"As a department of the National Education Association we are using every means possible to encourage local school systems to incorporate adequate programs of dental health education and corrective dental services in their school health programs. In this effort we are cooperating with the American Dental Association, the National Dental Hygiene Association, the American Association of Public Health Dentists, and the National Conference for Cooperation in School Health Education. Enclosed you will find our mimeographed reports relating to the National Conference. In the very near future we expect to appoint a committee to work directly with a committee from the American Dental Association in a direct attack on this problem. We shall be glad to work with you in any way possible."

Enclosed with this letter was a copy of the minutes of meetings of the National Conference for Cooperation in School Health Education, New York City, February 28 and March 1, 1941, in which a report by Dr. Morrey of the American Dental Association is as follows:

"Dr. Morrey reported that the chief school health activities of this organization centered in the information bureau and the Committee on Public Health Education in Dentistry. They have tried to develop materials which will be scientifically sound and useful in schools and for dentists in private practice. 'Teeth, Health, and Appearance' is a large illustrated book originally prepared for dentists' offices, but now is used also in schools. 'Your Child's Teeth' is a small pamphlet. He would appreciate suggestions on improving these publications to make them more effective for school use. The Association is now working on a sound motion picture for school use."

National Congress of Parents and Teachers: As stated previously, no reply was received from the National Congress of Parents and Teachers, however, the scope of the dental program of that organization is easily visualized by the report made to the National Conference for Cooperation in School Health Education, New York, February 28 to March 1, 1941. Mrs. Kletzer reported that

"this organization does not work directly with the school health program but is very much interested in supporting it. The material on the summer-roundup of pre-school children has been revised. A good deal of health material is published from time to time in the Congress magazine. Most of the

materials are not available to the public. Many of the members of the Conference are serving on various advisory committees for the Congress."

These reports make evident the need for one constructive program since the only plan which offers any hope for a solution of the present dental condition is a complete educational and corrective dental program for children beginning with the kindergarten age and continuing through high school age.

The replies received indicate that all of the organizations have desired to cooperate in any constructive program, and further, *that they all look to organized dentistry for the promotion and support of such a program*, and that they recognize the need for corrective and educational dental service as a necessary part of a complete educational system.

Before such a program can be generally accepted it is primarily essential that the National Education Association recognize its value and encourage its adoption. The importance of such a far-reaching step and the difficulties which will be met before final attainment can be hoped for are so great as to require that organized dentistry unite to make this a project of first importance.

4. AMERICAN ASSOCIATION OF DENTAL SCHOOLS, INTERNATIONAL ASSOCIATION FOR DENTAL RESEARCH, AMERICAN ASSOCIATION OF DENTAL EDITORS, OMICRON KAPPA UPSILON

The Committee, through Secretary Brandhorst, has maintained its contacts with the above organizations. Matters of mutual interest have been discussed and progress is being made. These organizations deserve the support and interest of all Fellows.

5. AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE:
SUBSECTION ON DENTISTRY

Dr. Paul C. Kitchin, Secretary of the Subsection on Dentistry, reports the following:

"In 1931 and 1932, largely through the efforts of Dr. W. J. Gies, the American College of Dentists, the American Association for Advancement of Science and the American Dental Association were granted associate status in the American Association for the Advancement of Science. This was the first recognition of dentistry as a participant in the activity of the

great group of scientific bodies making up that organization. The first meeting of a dental group with the American Association for the Advancement of Science was held in Atlantic City, New Jersey, in December, 1932, and the program was carried out under the auspices of our American College of Dentists. At Boston, in 1933, and Pittsburgh in 1934, the College continued to direct this activity. Later, in 1935, the American Association for the Advancement of Science recognized as an affiliate group the International Association for Dental Research because of its essentially scientific make-up. This group was accorded a representative in the Council and a voice in Association proceedings.

"For several years the American College of Dentists has maintained a Committee on Cooperation with the American Association for the Advancement of Science under the efficient guidance of Dr. Gies. Its suggestions and advice have been a great help to the officers of the Dental Subsection.

"With the admission to affiliate standing of the International Association for Dental Research, the Council of the American Association for the Advancement of Science created a subdivision of Section N (Medical Sciences) to be known as the Subsection on Dentistry (Nd). The membership of this subsection is made up of the official representatives of the four dental groups named above and in addition all other dental members of the American Association for the Advancement of Science. At present there are 220 members who have dental degrees and of this number about 20 per cent (45) are Fellows of the Association.

"The 1940 meeting of the Subsection on Dentistry was held in Philadelphia December 28th. The program was devoted to a symposium on periodontal disease. Abstracts of these papers were published in the *Journal of the American College of Dentists*.²

"The 1941 meeting will be held in Dallas, Texas, on December 29-30. The symposium subject will be 'Dental Fluorosis' and the program promises to be an interesting and instructive one.

"The Dental Subsection of the American Association for the Advancement of Science should be regarded by us as a legitimate child of the College and our interest should continue and grow.

"How about every member of the American College of Dentists becoming a member of the Subsection on Dentistry of the American Association for the Advancement of Science by joining this great scientific organization? It is one way of promoting dentistry's scientific development."

²See *J. Am. Col. Den.*, 8, 44; 1941, March.

6. BUREAU OF STANDARDS, CHILDREN'S BUREAU, UNITED STATES PUBLIC HEALTH SERVICE, AMERICAN RED CROSS, ETC.

Individual members of the College in Washington continue their cooperation with government and other agencies.

There is a serious need for definite and selective specifications (materials) for use by both federal and civilian dentists. The dozen or so now available through the cooperative research by the American Dental Association and the Bureau of Standards should be increased as rapidly as possible.

7. RADIO

The investigation of radio activities has been continued. The work was inaugurated last year by cooperating with those who are interested in the control of objectionable radio advertising. Aid also has been rendered to our affiliated organizations in a more comprehensive program of dental education.

In relation to the control of objectionable radio advertising of dental proprietaries, all action starts with the findings of the Federal Trade Commission. These reports have been read daily by your Committee but as yet, so far as is known, the Federal Trade Commission has not reported on the fraud of any concern which advertises nationally. Consequently no official action concerning objectionable advertising has been taken by our organization, as the Federal Radio Communications Commission will not recognize any protests unless definite findings of fraud have been published by the Federal Trade Commission. Obviously many dental proprietaries are sold and advertised against the law, but as can be seen, the elimination of this undesirable advertising is a very slow process. It should be emphasized that the Federal Trade Commission appreciates comments from all individuals regarding misleading advertising. The more protests they receive the sooner these products will be investigated.

We are again grateful for the invaluable assistance given us throughout this past year by the Council on Dental Therapeutics. Their offices at all times were most cooperative in explanation of the complications of the advertising situation of dental proprietaries.

The largest radio advertisers of dental proprietaries are the dentifrice manufacturers. As we know, certain rules have been laid down by the American Dental Association to which these manufacturers must comply if they desire to have their products on the accepted list and wish to advertise this fact. It is gratifying to observe that the Council is protecting the interests of the public and the profession by the close scrutiny of the advertised claims of all products and that they drop those from Accepted Dental Remedies, whose claims soar to fantastic heights from the calm, sober statements of facts allowed by the American Dental Association.

The Public Relations Committee of the American Dental Association has discontinued its radio programs on the Columbia Broadcasting System due to the lack of free time. It has been recommended that the future programs of the American Dental Association should be dramatized and of high quality.

8. AMERICAN MEDICAL ASSOCIATION

Contacts with the American Medical Association have been kept throughout the year with relation to radio advertising and education by radio.

9. NATIONAL DENTAL HYGIENE ASSOCIATION

Recently your Committee has been asked to obtain information relative to the National Dental Hygiene Association. Although the time has been short we have been able to gather a few facts.

The National Dental Hygiene Association was incorporated June 12, 1940, in the District of Columbia by the Martha M. Hall Foundation of New York. It is a lay organization with an honorary, advisory committee consisting of representatives from medicine, dentistry and health and welfare groups. The stated purpose of the Association is as follows:

"The Association seeks to *encourage social and civic-minded laymen and women* to become actively interested in the field of dental health to the end that they will *give support* to such worthwhile *community programs* under way or contemplated, as will *aid in the advancement of dental health for all the people*, and to stimulate all citizens to seek adequate dental care for themselves and for their children."

They further assert:

"The Association contemplates giving all possible aid to communities in the development of their programs. It *does not contemplate making financial grants for local service and educational programs* but rather to *encourage* local communities as well as the municipal, county, state and federal governments to *provide the necessary facilities and operating funds for adequate dental health programs.*"

The Association intends to remain independent, and maintains that,

"In contrast with professional groups, this Association, as a lay organization, solely concerned with the public welfare, will not be handicapped by the fear that it may be creating in the minds of the public a suspicion that its projects are being promoted for financial gain."

So far as we have been able to determine, the National Dental Hygiene Association is functioning in an entirely proper manner and it would seem that the organization is deserving of our whole-hearted support. It is true that there are many aspects of dental health education which can be developed by lay groups with greater efficiency than we can ever hope to approach. Laymen's self-interest may not often be questioned.

In spite of the fact that your Committee is very favorably impressed by its preliminary investigation we would prefer to hold our complete endorsement in abeyance until we have had more time to learn.

10. DENTAL HEALTH EDUCATION

The American Dental Association, in recent years, has developed and has available immense amounts of material which can be had almost for the asking. Pamphlets, models, motion pictures, lantern slides, exhibit material, etc., of high quality, may be obtained from the American Dental Association offices. We should use them.

In addition the American Dental Association Bureau of Public Relations issues news releases and health columns. Also, monthly public relations bulletins are mailed to the secretaries of component societies.

Education, here as elsewhere, is apt to be slow. The education of dentists in public relations techniques may be more difficult than

the education of the public. However, it is to be hoped that, with sufficient emphasis, the individual societies will learn the need for efficient public relations. A continued effort to organize, from top to bottom, our public relations, as suggested in previous reports would seem to be a worthy ambition. The consultants to your Committee, previously referred to, when asked if newsworthy material, presented at our own meetings, was being handled and prepared by ourselves to the best advantage or if the press was giving it the best of attention replied almost unanimously, "No!"

In past reports your Committee has urged the development of dental health education in lay magazines. The American Dental Association has promoted this type of activity. Also, the Dental Information Bureau of New York has made notable contributions. This latter organization is responsible for recent articles in the *Ladies' Home Journal* and *Physical Culture*. Previously they supervised and directed dental stories for *Life*, *Hygeia*, *Parents*, *McCalls*, *You* and others. It would seem that a continuation of these efforts by both the American Dental Association and the Information Bureau is desirable. The consultants to your Committee were asked their opinions on this type of publicity. It must be remembered that these consultants are numerous and widely distributed throughout the United States. They are among the leaders in dentistry. They, almost without exception, are in hearty agreement as to the great value of lay magazine dental publicity. It is our opinion that their judgment should be respected and that greater efforts should be made in the future. Perhaps the work of the American Dental Association and the Information Bureau can be increasingly coordinated.

RECOMMENDATIONS

- (1) The Consultant system should be continued and developed.
- (2) The College should encourage the Army to provide complete and adequate care for soldiers.
- (3) The College, through the Board of Regents, should state its position concerning the dental health of the nation, the ill effects on the general health, and should offer suggestions as to rehabilitation.

(4) The College should encourage all Fellows to take an active interest in the dental progress of public health departments: local, state, and national.

(5) The College should also encourage all dental organizations to take a similar interest.

(6) The College should encourage all Fellows to cooperate with character-building agencies in the development of their dental programs.

(7) The College should encourage all Fellows to become members of the Subsection on Dentistry of the American Association for the Advancement of Science.

(8) The College should encourage an increase in the number of definite and selective material specifications for use by dentists.

(9) The College should offer encouragement to the Council on Dental Therapeutics of the American Dental Association by an expression of appreciation of what they are doing.

(10) The College should indicate to the National Dental Hygiene Association its desire to cooperate whole-heartedly in their effort to improve dental health if, after adequate investigation, the organization proves to be what it seems at present. This will be based upon study of the plans and purposes of this association and, of course, dependent upon acceptance of the same.

(11) The College should encourage public dental education and express the appreciation to the Bureau of Public Relations of the American Dental Association and the New York Information Bureau for their efforts.

(12) The College should, through its Fellows, individually and collectively, do what it can to assist the American Association of Dental Schools and the American Dental Association in attracting desirable young men to enter the dental profession. This is especially necessary at this time due to the shortage of dentists.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE¹

PROCEEDINGS OF THE SUBSECTION ON DENTISTRY, SEVENTH
ANNUAL MEETING, DALLAS, TEXAS, DEC. 29 AND 30, 1941

Compiled by PAUL C. KITCHIN, M.S., D.D.S.

Secretary of the Subsection

Ohio State University, Columbus, Ohio

With the exception of a few miscellaneous papers, the entire three-session meeting of the Subsection on Dentistry was devoted to the subject, "Public Health Aspects of Dentistry with Special Reference to Fluorine". Almost all of the research workers who have had a part in the investigation of fluorine relations to dental conditions took an active part in this symposium.

Fluorine has been definitely proved to be responsible for the dental condition variously known as "Brown Spots", "Colorado Brown Stain", "Mottled Enamel" and "Dental Fluorosis". This enamel malformation, subsequently stained through other agencies, is due to the ingestion of water containing fluorides, during the tooth formative period. The severity of the condition is proportional to the amount of fluorides in the water supply used. Amounts in excess of two parts per million are capable of causing visible effects on the forming teeth. The period, during which a damage occurs, is the first 8 years of life, though all mottling is not visible until the 12th year when the affected teeth have erupted.

Mottled enamel, or more properly dental fluorosis, was first recognized and made a subject of study by Dr. F. S. McKay in 1903. From that time until 1916, McKay carefully followed the distribution of this condition and found it to be invariably associated with some factor active only within limited geographical areas. The first publication on this subject was made by McKay and G. V. Black in 1916.

¹For previous reports of the Subsection, see *J. Am. Col. Den.*, 5, 73; 1938, March-June. *Ibid.*, Footnote No. 1; also, 6, 56 and 184; 1939, March-June; 7, 74; 1940, March-June; 8, 44; 1941, March.

While all evidence pointed to communal water supplies as the source of trouble, many routine chemical water analyses showed the presence of nothing in the water of endemic areas different from that of non-endemic areas. A stalemate seemed to have been reached in the search for the cause of this disfiguring phenomenon. In 1930, with the advent of better methods of water analyses, McKay sought the aid of H. V. Churchill, chief chemist of the Aluminum Company of America. Churchill established beyond question the presence of fluorine in water supplies of numerous areas of endemic mottled enamel and its absence where no mottled enamel occurred. Fluorine feeding of experimental animals and production of dental fluorosis has confirmed the relation of fluorine to mottled enamel. Thus, through the careful and patient work of McKay, fluorides in communal water supplies became recognized as a public health problem. Many endemic areas changed over at much expense from deep well sources, with high fluorine water, to surface water supplies, free from fluorine. It is now routine with public health departments to test new public water sources for fluorine content before granting approval.

Thus far, as the symposium pointed out, fluorine plays a destructive role. Within recent years, however, evidence has been accumulating to indicate that its presence in small and optimal amounts in water supplies, seems to reduce materially the occurrence of dental decay. Whether this is accomplished through direct action, or through systemic effect on the oral organisms responsible for dental decay, or by absorption into the tooth enamel is not clear. However, the enamel of teeth resistant to dental decay has been shown to contain significantly greater amounts of fluorine than is present in those which are susceptible to dental decay. The symposium indicated that while the presence of an optimal amount of fluorine in the communal water supply may offer an easily applied public health measure for the reduction of one of our most prevalent disease conditions, dental decay, we do not yet know enough about the various angles of this beneficial aspect of fluorine to make intelligent and safe use of it in any large scale public health applications.

In conclusion, this symposium brought together the outstanding

workers in this interesting field. Their work has proved the detrimental effects of fluorine and indicated the possibility, it might even be said the probability, of very beneficial effects of optimal amounts of fluorine in the reduction of dental decay.

The business session of the Dental Subsection was held at the Dallas Athletic Club at 12:15 p. m., December 29, 1941. Dean F. W. Hinds presided. The Secretary announced the results of the mail ballot for chairman and third member of the Executive Committee for the 1942 (New York) meeting as follows: Chairman—Dr. A. H. Merritt. Third Member—Dr. W. J. Gies. The Secretary is elected for four years, the present term ending in 1942.

Dean Frederick Elliot of Houston was the official representative of the A.D.A. and Dean F. W. Hinds of Dallas acted in similar capacity for the A.C.D. and the A.A.D.S.

The 1942 (New York) meeting of the A.A.A.S. will be held December 28, 1942 to January 2, 1943.

The official abstracts of the papers presented at Dallas are presented herewith.

I. REMOVAL OF FLUORINE STAINS OR SO-CALLED

COLORADO STAINS

H. A. BERRY, D.D.S.

Holbrook, Arizona

Mottled enamel, commonly called Colorado Stain, Brown Stain or Dental Flourosis, is a malformation of the enamel.

In 1926, Frank Hannan, chemist of Toronto, suggested that fluorine was the cause of Mottled Enamel.

It has been demonstrated by Black and later by Williams, that the identifying characteristic of mottled enamel is the absence of the interprismatic substance between the outer one-quarter to one-third of the enamel rods. These investigators have reported that the dentin, as well as the enamel rods, is normal. Only the outer interprismatic substance is absent.

Black and McKay stated that the defective enamel was present at the time of eruption of the permanent teeth. Pigmented material may or may not be deposited in these chalky diseased areas after eruption.

For many years it was believed that the stain was internal in its source, but evidence has been found according to Montelius and McIntosh, to show that Ca or P as serum derivatives are not deposited in considerable amounts with the stain pigments. It is likewise clear that Fe and its precursor hemoglobin are not the cause of this stain.

Since the outer portion of the enamel is incompletely formed, it is possible to wash it away with such a chemical as trichloroacetic acid. The stain cannot recur because the involved layer has been removed from the enamel. The soundness of the underlying normal layer insures against a technical mishap, provided, of course, the tooth enamel treated has not broken down completely.

2. DENTISTRY AND CHILD DEVELOPMENT, INCLUDING FLUOROSIS

D. B. HARMON, *Education Coordinator*
Texas State Department of Health
Austin, Texas

This material is not a finished demonstration of a proven hypothesis, but is merely a presentation of some peculiar relationships found in a study of close work performance efficiencies in children. These relationships may indicate a causal association between malocclusions and performance deviations in children when visual sensation is the major one in the performance.

We have been making developmental studies on some 160,000 Texas elementary school children. These have been concerned with intersystemic efficiencies involved in certain school tasks, i.e., reading, writing, drawing, etc., and pathologies that may result if tasks are not well directed. The studies have been directed at children who do not seem to have histories of extra-school pathologies in the systems immediately involved in the tasks studied, such as histories of sensory, motor or neural difficulties.

In tasks involving close visual work our studies seem to show that, where no environmental restraints exist the child centers his activities around an axis determined by his point of fixation and at that distance at which he can resolve the materials with minimum effort and can continue the required task with minimum output of

energy. Diagrammatically this axis may be expressed as the perpendicular of an inverted isosceles triangle whose base is a line drawn between the centers of the eyes and whose apex is the point of fixation. Deviations from this produce distortions of visual image of learning and of reproduction. Improper lighting, bad seating and poor working materials produce distortions of this triangle and shifting of the axis of activity.

In initially pathology-free children, placed in learning environments where the above restraints exist, the children seem to adapt organically to the shifted axis of performance, with resulting bodily asymmetries that approach being mathematical equivalents of the restraining factors. So far our findings show 52 per cent of our group with performance inefficiencies related to these environmental factors, but some recent data shows many of these children (in one school 127 out of 460) with performance measurements and bodily asymmetries not correlating with environmental factors. Their measurements seemed to indicate that their axis of initial performance was deviating as a result of the systems determining this axis having adapted to some factor that was internal rather than external. The only common pathology found in these children was malocclusion, and there was perfect correlation between the direction of rotation of deviation of the axis of performance and the side of malocclusion with postures in the children, when at rest. This seemingly indicated that the axis deviation was instigated by the statekinetic reflexes in adjusting the eyes to the head tilt in chewing stress.

The following tentative hypothesis is advanced: Children with unequal chewing stress, such as found in malocclusion, shift their visual axis of performance, through the action of the labyrinthine and other reflexes. This results in a development of other bodily asymmetries, if their close performance work involving vision as a primary sensation is carried on in school environments that restrain free performance.

3. FLUORINE AND DENTAL CARIES

PHILIP JAY, D.D.S., M.S.

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An inverse correlation exists between fluoride bearing water and communal dental caries rates. Whole communities may have a remarkably low caries rate even when the fluoride content of the water is less than one p. p. m.² At this low concentration the incidence of mottled enamel is so low and mild in type that it has escaped the attention of the population involved. Until communities with equally low caries rates are found and which are comparable in every respect other than the presence of fluoride in the water, we may assume that fluoride is the factor responsible for the lessened caries activity.

Several questions have arisen concerning the relation of fluorine to dental caries. It is not known whether or not the increased fluorine content of the tooth renders it resistant to caries. It has been reported that caries free teeth contain a higher percentage of fluorine than carious teeth. It is also known that populations using fluoride bearing water have remarkably low saliva lactobacillus counts. This would strongly indicate that fluorine inhibits caries through its restraining effect upon the growth of bacteria associated with caries.

When fluorine is added to the water supply of rats it has an inhibitory effect upon caries. The addition of iodo-acetic acid to the rat ration has an even more pronounced inhibitory effect on caries in that animal. There is no evidence that the addition of fluorine to previously fluorine-free water consumed by humans will retard their dental caries activity. There is the possibility that to be effective the fluorine must be associated with some other substance or combination of substances.

²Parts per million.

4. THE CHEMISTRY OF FLUORINE AS RELATED TO FLUOROSIS

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In the period since 1930, when fluorine was first proved to be the cause of mottled enamel of human teeth, much has been learned of the chemical action of fluorine on both bones and teeth.

This element is widely distributed throughout nature, in both inorganic and organic combinations. The formation of fluorapatite explains the presence of fluorine in bones and teeth. The affinity of fluorine for the calciumphosphates has been used as the basis for the development of the bone filter for defluorinating drinking water.

Fluorosis may be caused by fluorine from sources other than drinking water. Cow's milk has been shown to be low in fluorine even when the cow is fed on a high fluorine diet. Unless the fluorine intake of an expectant mother is extremely high, the deciduous teeth of her child will not be mottled, due to the placental barrier.

Most crops grown in Arizona on soils enriched with fluorine do not absorb appreciable quantities of this element. Foods cooked in water containing fluorine appear to absorb some of the fluorine from the water.

5. RÉSUMÉ OF THE FLUORINE-CARIES RELATIONSHIP

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and*

MARGARET MATUSCHAK LEVIN, B.Sc.

*of the**Nutrition Fellowship of the Buhl Foundation at Mellon Institute
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In 1936 the Nutrition Fellowship of the Buhl Foundation observed that when sodium fluoride was fed to rats during pregnancy and lactation, the offspring developed teeth much improved in resistance to caries than in the case of animals from mothers on the same diet but without the sodium fluoride addition. Since the molars of rats erupt at, or after the end of, the lactation period, the fluorine could only have increased resistance to caries by processes active prior to eruption. The molars of these young rats were not mottled, hence

it would seem that mottling is not essential for caries resistance. The fluorine effect was acquired by an exclusively physiological route and suggests a true function of fluorine in the construction of caries-resistant teeth. We have concluded from a critical examination of the data of others, that caries resistance is a function of enamel structure due to preeruptive influences, one of which is the presence of an optimum amount of fluorine in the diet. We have suggested that the fluorine content of community water supplies be regulated seasonally to give the optimum dosage of fluorine for children, when that dosage has been determined. Obviously, such a program will necessitate a relative exclusion of all other fluorides from the dietary.

6. FLUOROSIS STUDIES AT THE UNIVERSITY OF MINNESOTA
W. D. ARMSTRONG, Ph.D., M.D.

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The fluorine contents of fifty specimens each of enamel of sound teeth and of sound enamel of carious teeth were found to be 0.0111 ± 0.0020 per cent and 0.0069 ± 0.0011 per cent, respectively. The enamel of slightly mottled teeth was found to contain 0.0245 per cent fluorine and the dentin 0.037 — 0.041 per cent fluorine. The enamel of severely mottled teeth contained 0.033 to 0.036 per cent fluorine. The enamel and dentin of teeth of inhabitants of Tristan da Cunha were found to contain higher than the normal amounts of fluorine. Experiments with mature rats receiving high fluoride water yielded evidence that a secondary enrichment of the dentin with fluorine occurs but that this process does not continue indefinitely. The same experiments indicated that the enamel of mature teeth can acquire fluorine through the outer enamel surface. Extra fluorine has been shown to inhibit caries in the rat when supplied (1) during development of the teeth, (2) concurrently with the caries producing diet, and (3) before the animals were given the coarse-particle diet. A diet believed to be complete, but containing less than 0.2 p. p. m. of fluorine has been devised.

7. FLUORINE INVESTIGATIONS AT THE UNIVERSITY OF ROCHESTER

JAMES T. GINN, B.S., D.D.S.

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These investigations have been carried out at the University of Rochester by the Carnegie Dental Fellows. They were not clinical studies but confined to laboratory experiments. Three generalized types of projects have been attempted and they may be classified as (1) bacteriological, (2) biochemical, and (3) nutritional.

The bacteriological studies were concerned with the effect of various concentrations of fluorides on the growth and acid production of representative types of oral microorganisms. Fluorine concentrations of less than one p. p. m. limit bacterial acid production but concentrations in excess of 250 p. p. m. are needed to influence bacterial growth. The presence of fluorosed and fluorine-treated enamel and dentin reduced acid production by bacterial cultures.

The radioactive isotope of fluorine (F^{18}) was used in several biochemical investigations. When radioactive fluorine was injected intravenously into cats, the isotope appeared in the saliva from the submaxillary gland within one minute. An average of 0.082 per cent of the isotope was detected in the saliva within twenty-one minutes. In a similar investigation the greatest deposition of the radiofluoride took place in the bones, with significant amounts in the dentin and negligible quantities being present in the enamel. In vitro experiments revealed the ability of powdered enamel, dentin, bone and intact tooth surfaces to absorb fluoride. Accumulated evidence indicates that tooth substances with absorbed fluoride have a reduced acid solubility.

The nutritional studies dealt with the inhibition of experimental dental caries in the rat by dietary fluoride. The daily administration of three mg. of KF to the coarse corn, caries producing diet caused an approximately 70 per cent decrease in the rat caries incidence. The ability of casein contaminated with fluoride to produce similar results has been established. After the salivary flow was reduced

³This paper was read by J. F. Volker, A.B., M.S., D.D.S.

by the extirpation of the salivary glands, dietary fluoride was still effective in limiting rat caries. Topical applications of a fluoride solution to the tooth possibly reduced the caries incidence. Fluorine, when added to a rachitogenic diet, appeared to increase the life span of rats.

8. MOTTLED ENAMEL: A SURVEY OF THE EARLY HISTORY OF ITS INVESTIGATION; THE STEPS WHICH LED TO THE DISCOVERY OF ITS CAUSE; AND SOME CONCLUSIONS AND UNIQUE FEATURES

FREDERICK S. MCKAY, D.D.S.

Colorado Springs, Colorado

Investigation concerning the cause of mottled enamel was started by the Colorado Springs Dental Society about 1903.

The first work was the examination of public school children of the city and surrounding territory. This established the fact that the native population was the only class afflicted.

It was soon established that the cause was present in the domestic water supply.

Dr. G. V. Black's interest greatly assisted the scientific study of the problem.

Routine chemical analyses of water supplies led to no conclusion. It became evident that the lesion was peculiarly associated with the use of water derived from deep sources.

The presence of fluorine in water from endemic districts was first determined by H. V. Churchill, Chief Chemist of the Aluminum Company of America.

A substitution of non-fluorine water for the former fluorine bearing supply in two endemic towns resulted in the absence of mottled enamel in children born after the change had been effected.

This research was the first to point out that fluorine had an inhibitory influence on dental caries.

Certain conclusions can be drawn from the facts disclosed by the investigation, and several unique features in the investigation have been recorded.

9. EXPERIMENTAL PRODUCTION OF MOTTLED ENAMEL

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The experimental production of mottled enamel in the rat is discussed. Emphasis is put upon the histological findings, the cellular reactions and the possible mechanism whereby the calcification of enamel is disturbed. Brief reference is made to the normal histophysiology of the incisor of the rat and to some of the important by-products that have resulted from the experimental histologic studies of fluorosis. These last are the normal rate of apposition of enamel, the neonatal ring and the recognition of the possibilities connected with tooth-ring analysis.

10. MOTTLED ENAMEL FROM THE STANDPOINT OF THE PUBLIC HEALTH DENTIST (INCLUDING THE RELATION OF FLUORINE TO DENTAL CARIES IN ILLINOIS)

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The first step in the study of fluorides and mottled enamel in Illinois was a survey in the winter of 1936-37 of all public water supplies in the state.

About seventy water supplies, serving 6 per cent of the state's population were found to contain in excess of 0.9 part per million (p. p. m.) of fluorine as fluoride (F).

Most of these fluoride-bearing waters are in a rather limited area since a survey showed that fluoride in amounts of 1.0 p. p. m. or more is found only in the water from rock wells, and it is such wells in only certain areas that furnish water high in fluorides. The highest fluoride contents are near the zone of influence of an ancient volcanic dome and it is probable that the intrusion of volcanic material into these strata accounts for the fluoride.

In twenty-five communities with water supplies containing fluoride (F) from 1.0 p. p. m. to 4.0 p. p. m., approximately 1100 children were examined for mottled enamel. It was found in vary-

ing degree wherever a water containing fluorides in excess of 1.0 p. p. m. was used. Above 1.0 p. p. m. the percentage incidence of affection and the severity increase quite rapidly. With 2.0 p. p. m. or more, all of the children using the water from birth can be expected to have mottled teeth in a readily observable form.

The 551 children using fluoride water (1.0 p. p. m. or above) had a total dental caries experience rate, including deciduous and permanent teeth (untreated dental caries, extractions indicated, missing and filled), of 274 per hundred, while the children using water containing 0.0 p. p. m. to 0.5 p. p. m. had a total rate of 481 per hundred.

The total dental caries experience rate of 164 picked white selectees living in twenty-seven communities, who were born and had lived their entire lives in municipalities in endemic (1.0 p. p. m. or above) areas, was found to be 530 per hundred as compared with 1016 per hundred for 164 selectees (general population) who were born and had lived continuously in ten communities in nonendemic (0.0 p. p. m. to 0.5 p. p. m.) areas.

In order to determine the early effect of fluoride-bearing waters of 1.0 p. p. m. or more, seventy-seven white selectees were chosen from seventeen cities who had lived in endemic communities the first eight years of life but who later resided elsewhere.

This group was compared with eighty-two white selectees (general population) who were born and had lived the first eight years but not their entire life in nine communities in municipalities in nonendemic areas.

The total dental caries experience may be compared as follows: The selectees who were born and lived the first eight years of their lives, but not their entire lives, in endemic areas have a total rate of 581 per hundred, as compared with a total rate of 1077 per hundred for the selectees born and who lived the first eight years of their lives, but not their entire lives, in nonendemic areas.

Calculating the standard error of difference, we find that the difference in the dental caries experience between selectees living in endemic areas their entire lives and those living in nonendemic areas their entire lives is 18.94 times the standard error, while for

the dental caries experience of selectees living in endemic areas the first eight years of life, but not entire life, is 13.24 times the standard error.

II. BROWN STAIN OF THE TEETH

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In the fall of 1940 a patient was recommended to me for diagnosis and corrective treatment. There were many interesting features about this case. First, the type of case; second, the diagnosis, and last, but not least, the corrective measure taken to restore the patient's mouth from both a functional and an esthetic standpoint. Chronic endemic dental fluorosis is a condition common to a great many localities. It is reported that 86 per cent of this condition found in the United States is found west of the Mississippi and 28 per cent of this 86 per cent is found in Texas.

Brown stain, or mottled enamel as the condition is often called, usually occurs in definite localities; occasionally we find brown stain coming from localities where it is almost unknown. An instance of rare occurrence is one coming from an East Texas area where only one other known case has been reported. A color film is presented of this case.

The features of the case which seem to be unusual, are first, decay occurring in a number of the teeth; second, two unerupted third molars with brown stain in the enamel; and third, that the teeth were of a deep brown color.

No fluorine has been reported in the section of the state concerned, although it is occasionally found in shallow water. An extracted tooth from this patient was sent to the University of Arizona for a spectroscopic analysis. The report of their investigation would lead us to believe that the stain was not caused by fluorine. The teeth have the appearance of mottled, or brown stain teeth.

In this case it was apparent that the primary calcification by colloidal calcium has not been matured to the crystalline stage.⁴

The colloidal calcium stage of enamel is known to be more per-

⁴Diamond and Weinman—Columbia University, 1940.

meable, being able to take fluid from the mouth. Mottled enamel from fluorine is known to be relatively immune from dental caries while this condition had no immunity; on the contrary we find that the case reported was more susceptible to dental caries than ordinary teeth, which have normal crystallization of the colloidal calcium with the known appearance of natural teeth.

In summary, some of the interesting features of the case were as follows: Many of the teeth were decayed, two unerupted third molars were stained, practically all of the stain as presented was in the enamel, although the dentin was stained to some extent. The dentin was harder than usual. The surrounding tissue was in excellent condition.

12. BLEACHING OF MOTTLED ENAMEL

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Since the cause of mottled enamel is now generally accepted to be the use, during calcification of the teeth, of drinking water containing an excess of fluorides, its prevention becomes a civic, or individual, responsibility. The treatment of teeth already affected, however, is the concern of the dental profession and will remain so as long as such cases occur. There have been three relatively successful methods of removing stain from mottled enamel advocated in recent years. Grinding of the stained surfaces fails to achieve the desired esthetic result when the stain penetrates deeply into the enamel. Treatment with hydrochloric acid of sufficient strength to remove the stain will result in decalcification of the enamel, and must render the tooth more subject to dental caries. The bleaching method, as first described by Dr. J. Wilson Ames in 1937, offers the most satisfactory results without affecting the structural integrity of the enamel. A mixture consisting of five cubic centimeters of 30 per cent hydrogen peroxide and one cubic centimeter of anesthetic ether freshly prepared for each treatment is used to saturate an absorbent roll ligated over the teeth to be bleached. These teeth are isolated with a rubber dam. Heat is carefully applied to the saturated roll in order to vaporize the liquid. As the roll dries, more liquid is applied; this is in turn vaporized, and the

process repeated until the entire six cubic centimeters of bleaching solution is consumed. Treatments may be repeated at weekly or semi-weekly intervals, until the desired bleaching effect is obtained. If cases are properly selected and treatment technique is carefully carried out, the results will be gratifying to both patient and dentist.

13. FACTORS IN CARIES IMMUNITY IN AND AROUND DEAF SMITH COUNTY, TEXAS

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Director of Dental Health
Texas State Board of Health
Austin, Texas

Caries immunity in and around Deaf Smith County was discovered more or less by accident, following the contention of a local dentist and the denial of other nearby dentists regarding a lack of caries in this area.

Description of country—Deaf Smith County is in a high, level, semi-arid plain area of northwest Texas, bordering New Mexico. There is an abundance of sunshine over a comparatively large part of the year. The soil is a uniformly dark, sandy loam of some twelve to eighteen inches, underlaid with a clay known as caliche. Caliche is from 75 to 83 per cent soluble calcium (CaCO_3). The cultivated topsoil is impregnated with particles of caliche.

Water supply—The water supply comes from a depth of seventy to eighty feet, both in the city of Hereford (municipal) and the rural areas surrounding. The rural and suburban homes are supplied by windmill wells which also irrigate garden and truck patches. There is a considerable amount of industrial irrigation for farming. The waters contain from 2.2 to 2.7 p. p. m. of fluorides.

Foods—Foods are extremely high in phosphorus, ranging from more than five times the average in flour, which is abundantly grown there, to double the average in garden and truck vegetables and 30 per cent higher in milk and dairy products. The calcium in these foods is slightly above average.

The people—The people of this area are typical western Americans, the racial stock being principally German, Irish, Scotch and a blending of these three races. There are no Latin-Americans or

negroes. For the most part, they are hardy, sturdy stock. They live a free and open life, comparatively exempt from nervous tension. They are thrifty in their domestic life, growing and consuming a great variety of foods for their tables. This abundant variety appears to be due to the virgin soil and irrigation.

Description of the teeth—The teeth of the native people are almost invariably short, square, strong and blocky, with very flat cusps and shallow grooves and pits in the posteriors, many times to the extent of perfectly flat occlusal surfaces. A considerable amount of erosion on the incisal and occlusal surfaces is evidenced, even in the deciduous and young permanent teeth. The fluorosis classifies as very mild, with a very few questionable or moderate cases. The mottling is largely of the white, chalky variety, only a few having a trace of brown stain. The DMF per child of the continuous history children for the Hereford public schools was 1.05. For the twelve, thirteen and fourteen year-olds, it was 1.01.

Gatesville—Similar studies were made at Gatesville, Texas, near the center of the state, with the same technique and examiner, where the fluoride content of the waters is almost identical with that of Deaf Smith County, but with different physical environmental factors otherwise. The DMF per child at Gatesville was 1.95—practically double that of Deaf Smith County. This indicates that, while the DMF at Gatesville is low compared with non-fluorine areas, there are factors involved other than the fluorides.

Post, Texas—Studies were made at Post, Texas, with a fluoride content of from 6 to 8 p. p. m., and under the same technique, the DMF per child was raised to 2.43. This indicates that there is an optimal fluoride level for immunity, above which the immunity is lessened.

Studies in correlating the *L. bacillus acidophilus* count with caries indicate that there is a positive relationship.

Conclusions—In Deaf Smith County caries immunity is approximately twice as high as the lowest heretofore reported in the civilized world. The immunity is produced by a combination of factors in proper proportion, along with fluorides, phosphorous, calcium and Vitamin D.

14. STUDYING PHYSIOLOGICAL EFFECTS BY
EPIDEMIOLOGICAL METHODS

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Although infrequently used, the application of epidemiological principles for the purpose of measuring physiological effects produced under natural conditions in relatively large population groups has proved of merit in the study of certain nutritional and pharmacological problems. The study of endemic pellegra in certain South Carolina mill villages, endemic goiter, the endemic dental fluorosis problem and the recent study of the possible effects of exposure to lead arsenate in an apple-growing region are a few instances of the use of these methods.

Each epidemiological problem presents its own varying sets of conditions, those recognizable necessitating careful appraisal prior to the inauguration of the study. Furthermore, it is evident that the populations compared be as nearly comparable as possible with the exception of the particular condition or variable under investigation. An analysis of the methodology used in the study of endemic dental fluorosis, a condition allowing the measurement of physiological effects, in different population groups by relatively precise quantitative methods, is illustrative of the manner in which epidemiological principles may be applied.

In endemic dental fluorosis the major requisites for a quantitative evaluation of the physiological effects due to ingesting fluoride domestic water are:

- (a) a common water supply whose history discloses no relevant changes in either its physical set-up, source or composition during the period concomitant with the life of the group examined, and
- (b) a population continuously exposed throughout life to the variable under investigation (the communal water supply) and of sufficient magnitude to permit the selection of a representative sample of individuals, preferably 12-14 years of age.

The effects of fluoride ingestion, as observed in 5824 white children of twenty-two cities of ten states, have been measured. The teeth were used as indicators. The fluoride (F) concentration of the domestic water in these cities ranged from 0.0 to 14.0 parts per million. Individuals were classified on the observed degree of affection as follows: Normal, questionable, very mild, mild, moderate and severe. By giving a definite arbitrarily selected weight to each degree of affection, a numerical weighted index was computed for each city and plotted against the fluoride concentration of the public water supply. A rather precise quantitative relationship between the two variables was observed, the present evidence of the relation between them manifested itself graphically as an ogive.

For certain physiological problems, particularly in the field of pharmacology and nutrition, the application of quantitative epidemiological methods may be a means of bringing to light physiological secrets latent in large population groups.

15. ORAL CONDITIONS IN A CASE OF CONGENITAL CYANOSIS

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Very little is known definitely concerning the causes of congenital heart disease, blue disease.

Holt groups the congenital anomalies of the heart under three heads:

1. Malformation, resulting from imperfect development of certain parts of the heart, most frequently the septa.
2. The results of fetal endocarditis.
3. The persistence of fetal conditions, such as the foramen ovale or ductus arteriosus.

All cases of congenital anomalies of the heart are characterized by clubbing (drum stick) of the fingers and toes, as well as a tendency of the tip of the nose to be clubbed. These are in proportion to the amount of cyanosis in the individual case. The fingernails are very curved, partially covering the ends of the fingers.

The red blood cell count in three cases seen by the writer averaged 9,400,000; white blood cells averaged 7200 and hemoglobin

was sharply increased over normal, depending upon the amount of cyanosis. There was a marked dyspnea in all cases. Boils or carbuncles were present. Epithelial tissues over the entire body lacked tone and the eyes were very red.

From a radiographic examination of the teeth and jaws there was revealed a loss of alveolar process to about the middle portion of the roots of all the teeth.

Clinical data show that oral conditions in adult cases of congenital cyanosis apparently follow a distinct pattern marked by a lack of keratinization of the gingivae, with spontaneous hemorrhage, resulting from the slightest irritation, marked cyanosis of oral tissues, especially over areas not supported by bone and in the tonsillar region. Inter-dental papillae are destroyed exposing the connective tissue without pocket formation. Penetrating ulcers were present in the tonsils and soft palate as deep as twelve millimeters.

The lack of resistance of the gingivae and oral mucous membrane gives the impression that lack of oxygen in the blood apparently affects not only keratinization but also the investing tissues of the teeth.

16. CLINICAL AND HISTOLOGICAL PICTURE OF MALIGNANT
TUMORS IN THE ORAL CAVITY, WITH CONSIDERATION FOR
THE SYMPTATOLOGY IN THEIR BEGINNING AND ESPE-
CIALLY IN CONNECTION WITH TEETH

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It is recognized that the diagnostic responsibility of the dentist is greater than merely to locate incipient caries, or to discover periodontoclasia.

The oral cavity with its different organs and tissues at the beginning of the respiratory and digestive tract is often the place where a general or systemic disease has its first manifestation. Such a disease, to mention only one, is agranulocytosis.

More important than this, or similar diseases, are tumors. Among them the most important in the oral cavity (especially of man) is cancer. For an *early* diagnosis of a *beginning* cancer, it is not enough to know only the differential diagnosis between the various kinds

of ulcers caused by trauma, tuberculosis, syphilis, leukemia, etc. Most of the scientific articles and textbooks restrict themselves to discussing only the changes of the mucous membrane in connection with a beginning cancer, and yet, mobility of a tooth, or teeth, is often the first visible sign. This symptom, if noted, is often hidden in the case histories among many other less important symptoms. By overlooking this condition there is not only danger of losing valuable time, gained by early diagnosis, but also there is the danger that through the mechanical injury caused by the extraction of one tooth or many teeth, there may be a sudden growth of the tumor. The mobility of teeth caused by malignant tumors sometimes has special clinical characteristics, and thus it may be considered pathognostic. In these cases, the tooth can be moved parallel with its axis, and it seems as if it were resting on a cushion.

Besides the mucous membrane and the teeth, there are sometimes pain symptoms during the development of a cancer. These range from a clinically typical trigeminal neuralgia to the opposite, numbness. On the other hand, there are some beginning cancers which can be confused with cysts because of a pseudo-fluctuation and indistinct x-ray films.

Cancer of the antrum of Highmore (maxillary sinus) may be confused with inflammation. *Early* diagnosis of cancer of the upper jaw is especially life saving, although sometimes it is very difficult from a clinical *and* roentgenologic standpoint. In many cases where the tumor appears clinically in the beginning stage, it has developed so close to the brain that the dura mater is injured during the operation or in after-treatment. Sometimes infection of the meninges occurs or a damage develops through radium application.

For early diagnosis, it is most important to bear in mind the possibility of the presence of a tumor. The main responsibility lies with the dentist who sees the oral cavity of a patient more often than the physician does.

In connection with cancer of the upper jaw, the dentist needs the help of a rhinologist and a very good skull roentgenologist. Without their help he cannot make the proper diagnosis.

To illustrate and explain visually some of the clinical symptoms, histological pictures of a squamous cell carcinoma (epithelioma) of the lower jaw, which penetrated into the mandibular canal, are presented.

ADDENDUM

Herewith is a list of membership of the Subsection on Dentistry (Nd) of the American Association for the Advancement of Science as of March 20, 1942. It is prepared from data supplied by Assistant Secretary Woodley of the A.A.A.S.

The arrangement of the names is according to the following plan:

I. Those resident in the United States, by states.

II. Those resident outside of the United States.

All members and fellows who do not have a dental degree are marked with an asterisk (*). The letters following each name indicate the section, or sections, of the A.A.A.S. in which the individual is interested. The first numeral indicates the year in which he was elected to membership; for example, "41" means 1941. A numeral indicating election to membership in the Subsection on Dentistry *before 1935* (the year of its establishment) means that membership in the A.A.A.S. *previous* to 1935 had been in affiliation with one or more other sections, the preferred sectional affiliation(s) meanwhile having been changed to, or to include, *Nd*. The letter F subsequent to this first numeral means that the individual is a Fellow of the A.A.A.S., and the figure following this F shows the year of election to Fellowship. The letter L following a numeral means that the individual is a life member of the association, and the year of becoming such is indicated by a numeral following the L.

The various sections of the A.A.A.S. and the letters designating them are:

Mathematics	A	Botanical Sciences	G
Physics	B	Anthropology	H
Chemistry	C	Psychology	I
Astronomy	D	Social and Economic Sciences	K
Geology & Geography	E	Historical & Philological Sciences	L
Zoological Sciences	F	Engineering	M

Medical Sciences	N	Agriculture	O
Subsection on Dentistry	Nd	Industrial Science	P
Subsection on Pharmacy	Np	Education	Q

The following example will aid in interpreting the letters and numerals following the names and addresses: Dr. Henry Black, 350 E. State Street, Columbus, Ohio, NdGC27F32L36. Dr. Black is interested in and listed with the Subsection on Dentistry, the Botanical Science Section and the Chemical Section. He became an A.A.A.S. member in 1927, was elected to Fellowship in 1932 and became a life member in 1936.

I. Members and fellows resident in the United States, by states:

ARIZONA

Paul H. Bennett, Valley National Bank Bldg., Tucson NdK40

John Vincent Cogan, 1709 E. Sixth St., Tucson Nd41

CALIFORNIA

Frank M. Casto, P. O. Box 507, La Jolla Nd42

Willard C. Fleming, 5924 McAndrew Dr., Oakland NdQF42

Sadi Bernard Fontaine, Medical Bldg., 1904 Franklin St.,
Oakland Nd40

R. B. Giffen, 228 Medico-Dental Bldg., Sacramento Nd14

John E. Gurley, 350 Post St., San Francisco QNd32

George M. Hollenback, Medical Square, 2206 W. Third St.,
Los Angeles Nd36

V. L. Hunt, Arcata Nd40

Jack Loop, 1315 E. Main St., Alhambra Nd41

John Mauer, University of Southern California, College of
Dentistry, 16th and Los Angeles Sts., Los Angeles NdIK40

Guy S. Millberry, Route 2, P. O. Box 181, Los Gatos KNdQ13F15

Harold Rider, 2644 Dwight Way, Berkeley CNdP42

George C. Sharp, 702 Citizens Savings Bank Bldg.,
Pasadena Nd29L32

W. G. Sheffer, Medico-Dental Bldg., San Jose Nd40

Ernest Sloman, 344 14th St., San Francisco KNd40F41

T. Sidney Smith, 85 Marcela Ave., San Francisco Nd32

*Marion Moseley Sniffen, 1030 E. California St., Pasadena NdIQ42

Harvey Stallard, 803 Medico-Dental Bldg., San Diego Nd28F33

Loren B. Taber, 870 Market St., San Francisco NdL17

COLORADO

Oliver H. Devitt, 523 Republic Bldg., Denver Nd41

CONNECTICUT

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New Haven Nd42
Lewis Fox, 72 West Ave., South Norwalk Nd42
John Hertz, 218 Bedford St., Stamford Nd41

DELAWARE

- Richard H. Stucklen, 1003 Delaware Ave., Wilmington ... NdH42

DISTRICT OF COLUMBIA

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J. R. Blayney, 5840 Stoney Island Ave., Chicago Nd33F33
Allan G. Brodie, 30 N. Michigan Ave., Chicago NdH36F41
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Stanley W. Clark, 180 N. Michigan Ave., Chicago NdC36
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- *Harold L. Hansen, 212 E. Superior St., Chicago CNd36F39
- *R. Wendell Harrison, Ricketts Laboratory, University of
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- Harold Hillenbrand, 100 W. North Ave., Chicago NdK38
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 18th and Buttonwood St., Philadelphia . . . Nd37
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 Robert Zugsmith, Allison Park . . . Nd32

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TEXAS

- Elza Ellington, P. O. Box 1070, Big Spring Nd41
 F. C. Elliott, 1018 Blodgett Ave., Houston Nd35
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 James Daughtry O'Farrell, 605 Scanlan Bldg., Houston Nd41
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 Robert H. Fladeland, U. S. Navy Yard Dispensary,
 Portsmouth NdEL40
 J. Frank Hall, Medical College of Virginia,
 School of Dentistry, Richmond NdQ39
 William N. Hodgkin, Warrenton Nd40
 Garland W. Holliday, Medical Arts Bldg., Richmond Nd39

WISCONSIN

- Henry L. Banzhaf, 615 N. 11th St., Milwaukee NdQ33
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 William Alexander McFarlane, 233 South St., Waukesha Nd41
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Fellows 55

Members 215

 Total 270

EDITORIALS

NOBLESSE OBLIGE

Noblesse Oblige! These two words constitute an expression of a code of conduct. They are often used to "denote the obligation of honorable and generous behavior associated with high rank or birth." It is not to be found among the statutes or commandments nor is it even a set of unwritten laws. It is higher than any of these—it is an *inner light* that must be followed by him who is so fortunate as to possess it. It is something that can be cultivated, should it germinate. It is something that can be sought after, found, and as a spark, fanned into a flame. Professional men should have it and to no small extent, they do. They occupy enviable places in society. They have been educated largely at the expense of the state. They stand well above the level of "poverty and obscurity" and have been benefited by other men's labors. During normal times, professional men continue their studies, adding to their knowledge and techniques and in turn, of course, render just return to society which made this possible.

This noblesse oblige is a code of conduct for the individual and for the group. But back of it or as a part of it, there is also a philosophy which gives it impetus. A profession is not an end in itself—it is a means to an end. It is a means by which one may render service to society and at the same time it is a means by which society may render service to the individual. In this reciprocal relationship, lies the development of the philosophy of the profession—the rendering of service each to the other and in that, the providing of comfort, satisfaction and happiness. A philosophy for the profession and a noblesse oblige for the members!

During all the years individuals have not labored alone in the further development of these "guides"—it has required the cooperative effort of all. Through the American Dental Association, the American College of Dentists, the International Association for Dental Research, the American Association of Dental Editors, the American Society for the Promotion of Children's Dentistry, and

many others, including the fraternities, men have been given opportunity for expression of ideas and for demonstration of techniques.

Presently we will meet again in annual session in the old city of Boston. We will participate in all of the activities of the A.D.A., administrative and professional obligations, public, educational and technical. Not the least interesting activity at this, the 84th annual session, will be that of the scientific and health exhibits. This phase of our educational process has made great strides within the past few years and does constitute one through which much of our growth has taken place. The present committee under Dr. Marre is entitled to great credit for their labors during recent years, even including the present. Similarly the sessions of all of the above-named organizations will contribute much to the good of the profession and its devotees.

However, noblesse oblige asks no favors for dentists—it is ours to do our part in these days in whatever way we may. It may be military service; it may be some form of civilian service; it may be merely the purchase of war bonds and stamps. But in whatever way we may be called upon, let us do our part. Fellows of the College will more likely be called upon to buy bonds and stamps. War bills run high; taxes will be high; prices of commodities will rise; wages have already increased; war costs have run higher than at first estimated; we must think in terms of planes, tanks and ships. We must buy bonds and stamps.

But there come other times, when this same noblesse oblige calls on us to think clearly and act accordingly. There may be times when we allow our thinking to become clouded and we are put to it to think our way through. For the past several years we have seen changes taking place within our journalistic sphere, just as changes have taken place within other spheres in the profession. Journalism has now come in the main, under the direct ownership of the profession. As is well known there are but very few of the old, now called proprietary type of journal left. This fact, including the change in type of material presented, and the new professional horizon, has brought about changed attitudes.

Competition between dental manufacturers has taken on a dif-

ferent form with the advent of the Research Commission of the A.D.A. and the Federal Bureau of Standards. It is no longer of any value to them to publish our material and which too is so much more expensive to publish. But this pertains chiefly to the technical side of dentistry. We have in these later years been brought into closer relationship with chemical manufacturers who are interested in some of the researches which may be published. With the advent of science into dental education and practice, there has been created the Council on Dental Therapeutics of the A.D.A. This committee becomes at once a guide and a protector. We can and should look to them for help or advice in any one of many ways. Our researchers have increased in numbers until today we have the International Association for Dental Research. This association publishes a splendid journal, *The Journal of Dental Research*. In all of these our advances are recorded and our responsibilities indicated.

All of these are manned by men. Man is not infallible. But man can be wise and counsel. Man, as he climbs into positions of greater possibility and assumes greater responsibility, must be more careful in his counsels, more cautious as to his philosophy and more alert as to his noblesse oblige.

Subtle influences are hard to determine and harder to lick. It is often difficult to distinguish between right and wrong. Many birthrights have been sold for a mess of pottage. And yet, as professional men are educated in college, they are taught something of ethics. Men are trained to be proficient in the scientific laboratory, both in undergraduate and graduate schools. In all of our organizations much emphasis is placed upon right conduct. In the American Association of Dental Editors we have been even more specific, in that we have discussed the use of reprints to a great degree. In the old days men purchased large quantities of these for distribution among non-subscribers or members of other professions or even for use among their patients. But not now. However, there are times when a chemical manufacturer may be interested as has so recently happened. Two articles appearing in *The Journal of Dental Research* for December, 1941, were of especial interest to a certain chemical manufacturing company. They purchased a sufficient

number and sent one to each dentist in the country, followed at a later date by a letter from them. The fault may not lie with them, for this is business. It may be in part charged to them in that they took advantage of the *simplicity* of these professional scientists. But be that as it may, this particular editorial board made a grievous mistake, one that cannot pass unnoticed by the profession. They are members of the editors association and should have been familiar with the discussion of such or similar points. They should have borne in mind the report of the Committee on Reprints, made at the Houston meeting and now published in the 1941 Proceedings.

A serious error has been made in this deal. This editorial board should make some manifestation of repentance. The profession, due to the position occupied by *The Journal of Dental Research*, cannot let this pass without definite protest. The members of the board should exonerate themselves by acknowledgement of their mistake, in order that their own positions of usefulness and of influence may not be injured. This is due the profession, but is of greater significance to them.

Perchance some one should be taken to task—but who? It may be suggested that somewhere along the educational line, failure to teach principles thoroughly lies at the bottom. Universities do make men proficient as they look into a test tube. These are scientists. Universities make men proficient in business, too. They are astute executives. Similarly, churches and other institutions make a lot of people good. But too many of these good people are dumb as to what is going on in the world. They have no sense of the realities of life. To a degree this is true of scientists. They are capable, so far as their laboratories are concerned, but they too are lacking in a sense of reality. These astute business men are capable, they are clever, they know how to make a profit. But . . . the scientist needs to have his astuteness whetted. He needs to think in terms of noblesse oblige.

PROBLEMS OF DISTRIBUTION IN PERIODICAL DENTAL LITERATURE

The editorial, "Journalistic Ethics," appearing in the issue of the *Journal of the American Dental Association* for February, 1942, contains the following passage:

"Much has been and is being said about the amount of dental material that is going unpublished, and while we are quite conscious that the amount of dental material being offered for publication is far beyond the available avenues of publication, we are, even though reluctantly, in the light of long experience slowly but surely coming to the conclusion that there is now being published practically all of the dental literature that is worthy of publication."

With our state and county periodicals serving as avenues of publication for at least a part of this material, it may well be that in one way or another there is now being published all the dental literature that is worthy of publication. There are over a hundred recognized dental journals in the country. Since they all have to be kept going, it is easily possible that even more dental literature is being published than is worthy of publication, and that much of the worthy material is being regurgitated. The fly in the ointment is the fact that many of these journals are so limited in circulation that a worthwhile article published in one of them is practically lost to the world. A competent critic has correctly observed:

"These journals not only overlap and duplicate one another's efforts, but scatter good material about through so many publications that even the least ambitious dentist must subscribe to five or six journals in order to know even approximately what is happening in the dental profession."

The problem, then, seems to be not so much a matter of production as of distribution—how to bring to the profession, directly and quickly, all the worth while dental literature that is now being published.

Writing on this subject in the issue of the JOURNAL OF THE AMERICAN COLLEGE OF DENTISTS for December, 1941, page 295, Dr. Walter Hyde reminds us that surveys have been made by separate bodies, notably one by a committee of the American Dental Association, and that material has been assembled that could be worked into an adequate (journalistic) pattern. "That this valuable material," he adds, "should be allowed to remain buried in the records of the greatest dental society in the world is a reproach to the influence responsible for this neglect."

What this influence is or how it has been exerted we, of course, have no means of knowing, but it suggests a sinister situation. Nor are the shadows dispelled by Dr. Hyde's cryptic assertion that "the

Journal of the American Dental Association needs more aggressive editorial leadership, which political influence may now render impossible." Perhaps, in this guarded reference to political chicanery in the national organization, we may have an explanation of the fact that the old *Dental Cosmos*, in spite of its commercial background, showed more editorial leadership than does the *Journal of the American Dental Association*.

Our most important dental publication, of course, is the *Journal of the American Dental Association*. It is received directly by some 53,000 dentists, not one of whom we can imagine standing with his nose pressed against a window pane watching for its delivery. Not that this is any reflection upon the editor, for the same might be said of any semi-scientific publication received by professional men anywhere. In this connection however—and by the way—we cannot refrain from commenting upon the many scientific articles appearing in that *Journal* which are documented with such an extreme of prodigality as to cause one to wonder about the extent of the writer's actual contribution to his subject.

As to the reason for maintaining the *Journal of the American Dental Association* in its present dual role of scientific journal and bulletin of organization activities: that, probably, is a matter of economy. As we all are aware, there never has been an organization whose finances kept pace with its ambitions. In such cases, whatever the income—whether much or little—it is never enough. With the recent increase in dues, however, it would seem that the A.D.A. might well afford to dissolve this unholy union of a journal and a bulletin, and so convert the present *Journal* into two distinct publications: one scientific, and the other a bulletin of Association activities. In this way, under careful editorial direction, a goodly portion of the "worthy literature" that is now going around in circles would be carried directly to the membership, and a start would be made toward giving our present muddled journalism direction and effectiveness.—C. F. H.

STREAMLINED DENTAL MEETINGS

To the poet's query, "What is so rare as a day in June," many could truthfully answer: "A dental meeting that operates on schedule and speakers who stay within the time allotted to them." This answer would be correct, too. It is difficult to recall when a dental meeting was opened at the appointed time; when all the essayists stayed within their allotted time; and when the meeting adjourned at the time scheduled for it.

Meetings scheduled to convene at 9:30 a. m. are usually not called to order until 10 or 10:15 a. m. The motive behind this dilatory procedure is the erroneous assumption that people are by nature habitually late, and that this method must be used in order to get the members into their seats at a given time. There is nothing further from the truth. People are not habitually late when they know that a schedule will be strictly adhered to. Very few people are late when they expect to catch a train. They know that, as a rule, a train moves on the announced schedule, whether they are on it or not. People arrive late at the assembly hall mainly for two reasons: first, because they are not particularly interested in the program; second, because experience has taught them that meetings are usually called to order thirty to forty-five or more minutes behind schedule. It is but natural for them to conclude: "Why be on time when the meeting will not start until later anyway." Thus, throughout the reading of the first paper many members dawdle into the hall, disturbing those already seated. Certainly, this is not very complimentary to the essayist then reading.

What can be done about it? First, be sure that the program has been correctly scheduled; that proper time has been allotted to every item on the agenda. Put an emphatic statement in the program that there will be positively no deviation from the schedule. *Then, start the meeting at the time stated on the program.* The assembly hall may be as bare as the proverbial Mother Hubbard's cupboard, but start the meeting anyway. Do not be dismayed if results are not immediately discernible. An evil that has been condoned for a long period cannot be eliminated by magic. It may require several attempts to get results; but results are sure to come, if those in charge

of the meeting have the courage to stick to a system of punctuality.

A system of punctuality should be required of essayists also; not that they are late in starting their addresses, but because so many of them are late in finishing them. Often, essayists with half-an-hour allotted to them so completely disregard the schedule as to consume a whole hour, apparently oblivious of the fact that in this way they not only put the schedule into a tailspin, but the audience as well. Two reasons for this disregard might be carelessness and conceit: carelessness in the preparation of the paper; conceit in believing that the utterances are so important as to merit the intrusion into the time previously allotted to another.

What can be done about it? Put forth greater effort in the preparation of the paper. Before going to the meeting, read the paper. Time it! Does it run over the allotted time? Condense and eliminate! Can't do it? Oh, yes you can! *Reader's Digest* does a mighty good job of condensing best sellers of four to five hundred pages into thirty pages, more or less. Broadway hit-shows, running two and one-half hours normally, are condensed for the radio into thirty-minute productions. Certainly a paper can be condensed, and it can be done without destroying its vital points. Another thing that could be done: the chairmen could unobtrusively warn the essayist a few minutes before his time is up. Should this warning be ignored, time could be called on the speaker. Embarrassing? Of course . . . until all get the idea.

Apparently, it is fully understood that it is important to adhere to a strict time-schedule, in the dispensation of professional service, to achieve maximum success. This same philosophy can be applied with equal success in conducting dental meetings. The beneficent results will more than justify the effort.—C. W. K.

PLASTIC METHYL METHACRYLATE: PROPERTIES AND UTILITIES

The issue of the *Journal of the American Dental Association* for April, 1940, contained an article by P. B. Taylor on the vulcanization of rubber. This article touches on the polymerization of methyl methacrylate and was followed by another on acrylic resins in the issue of the same *Journal* for March, 1941. These

articles are recommended not for superficial reading but for serious study by those interested in this intriguing new plastic, now so widely used as a denture-base material. The article on acrylic resins is so thorough in describing the behavior or phenomena of the material during processing that scarcely anything has been added to our knowledge on the subject since its publication, with the possible exception of another method of applying the pressure during the processing of a denture. In fact, some of the subsequent articles and speakers have caused confusion through lack of understanding or knowledge of Taylor's researches.

As an example: during the past few months men with meager knowledge of the subject have been prattling about internal strains set up in the material by one method or another of curing, as if internal strain was a very recent discovery. Three years earlier, Taylor described and photographed them for those able to read intelligently. Internal strains are of no practical concern unless they cause trouble. An illustration is the strain which caused the checking of porcelain teeth. Means have been described which overcome this trouble, the most effective of which are pressure molding, softening the plastic by the addition of other ingredients, or a long cure at low temperature. As a matter of fact strain has always been present in every cast, wrought, ceramic or plastic piece of work. It is present in every wax inlay-pattern also. While painstaking means should be taken to overcome any unfavorable result of these strains, they are most certainly not new; and, like the poor, will always be with us.

Among the points elaborated by Taylor are these: (a) Initial curing expansion. (b) Subsequent contraction—causing checked teeth, etc. (c) Generated exothermic heat, which sends the temperature up as much as 100° F. higher inside the plastic than the temperature of the water-bath which heats the flask, this condition causing porosity. (d) Compression strains overcoming, or counteracting, strains set up by shrinkage. (e) Suggestion of slow heat-up, and low heat at least in the early stages of curing, to overcome porosity.

Among some of the products of the imagination of many who should know better, aside from the lack of understanding of strains, can be listed the following:

"All acrylic work should be protected by a covering of some sort, in case of an ether anesthetic, or it will be attacked and dissolved." The fact is that ether is a very poor solvent of the acrylic, and no unusual precautions are necessary. With chloroform, an active solvent, the case would be different; but who uses chloroform for prolonged anesthesia? The same nonsense has been heard and repeated in regard to alcoholic beverages. The soft tissues of the mouth tolerate far less of any of these drugs than the plastic, which also withstands the strong acids.

"Acrylic is a permeable membrane, so many pulps will be devitalized under it." Acrylic resin's imbibition of water is of no practical consideration. It is very slight and not at all of a fouling nature. In fact, the crown of a natural tooth imbibes approximately two and one-half times as much water through the enamel.

"If processed by the injection method it has strains so it will warp at mouth temperature." No evidence has been presented to support this statement. But the material is new and almost incomprehensible. In its monomeric or liquid form, exposed to the air, it evaporates and disappears like chloroform; but, confined in an airtight container, it solidifies to form a crystal-clear, strong, dense solid. Nothing that can be conjured in fancy is as wondrous as this material in fact.—*W. J. P.*

DENTAL PARTICIPATION IN THE ADVANCEMENT OF SCIENCE

The Secretary's report of the proceedings of the seventh annual meeting of the Subsection on Dentistry ("Nd") of the American Association for the Advancement of Science is presented on pages 229 to 259 of this issue. The meeting, held in Dallas, Texas, on December 29 and 30, 1941, was highly successful, as may be seen in the Secretary's introductory statement and the succeeding abstracts. The dental sessions again demonstrated the ability of dentists to participate effectively in the work of the A.A.A.S., which is the chief and most general representative of "organized science" in the United States.

We regret to add, however, that growth of practical interest in this phase of dentistry's "public relations" is not very active. We

call special attention to the "list of membership" in the Addendum to the Secretary's report of the Dallas proceedings (page 229), which is an honor roll of dental participation in the advancement of science. That list shows that the number of persons who have become members of the "Dental Section" (since it was organized in 1935) is only 270, of whom 16 are not dentists ("do not have a dental degree"). Of the 254 dentists in this membership, 246 have indicated the "Dental Section" (*Nd*) as their *first* choice of a maximum of three sectional affiliations. Of the latter total—we learn from the May issue of the *A.A.A.S. Bulletin*—39 were added during the period from October 1, 1941 to March 11, 1942, inclusive.

Dentists who desire to participate in the work of the A.A.A.S. are eligible for election to membership. Members receive not only the monthly *A.A.A.S. Bulletin* but also either weekly *Science* or the *Scientific Monthly* as they prefer. Members are free to indicate annually their selections of three sections (of the existing 18) to which they desire their membership to be officially accredited. The Executive Committee of the "Dental Section" annually nominates members (accredited to affiliation with that Section) for advancement to Fellowship.

The following comment is quoted from an editorial in the issue of this *JOURNAL* for March, 1941 (page 65):

"Dentists wishing to learn about the functions of the A.A.A.S., and the ways in which dentists *animated by the spirit of scientific progress in dentistry* can participate in the activities and professional benefits of 'organized science' in America, would receive related information by addressing inquiries to the Secretary of the 'Dental Section'—and its representative in the Council of the A.A.A.S.—Dr. Paul C. Kitchin, College of Dentistry, Ohio State University, Columbus, Ohio."

We hope that an increasing number of dentists will become members of the A.A.A.S., and thus cooperate actively in the effort to make the advancement of dental science one of the leading objectives of that Association.—*W. J. G.*

CORRESPONDENCE AND COMMENT

STATEMENT OF ACTION OF HARVARD ALUMNI CORRECTED AND CONFIRMED

In your issue for December, 1941, you stated (page 301) that, at the annual meeting of the Harvard Dental Alumni Association on June 18, 1941, there had been "unanimous adoption, after discussion, of the following resolution:"

"Mindful of the attainments of dentistry of the past, the activities of the present, and the hopes and aspirations of the future, the Harvard Dental Alumni Association believes that continuance of the autonomy of dentistry is essential in the public welfare."

This phraseology is nearly, but not quite, correct. This resolution was recorded in the minutes, and approved by the Council of the Association at its meeting on October 2, 1941, in these words (the divergences from the above are indicated by italic below):

"Mindful of *dentistry's attainments* of the past, the *quality of its present activities*, and *its hopes and aspirations for the future*, the Harvard Dental Alumni Association believes [*that*] continuance of the autonomy of dentistry is essential in the public welfare."

The edited form of this resolution, as officially recorded, did not alter the import of the resolution or of any part of it—(3).¹

Comment. The fact stated in the last preceding sentence emphasizes the correctness of the impression conveyed by the earlier unedited form—that the Harvard Dental Alumni Association does not favor the purpose of the new dental program at Harvard to initiate a movement to bring about termination of the autonomy of the dental profession.

We have been informed that, at the meeting on June 18, 1941, a standing committee of five which on November 8, 1940, had been "appointed to represent the Harvard Dental Alumni Association in any matter pertaining to the proposed changes at the [Harvard] Dental School"—of which Dr. John W. Cooke was chairman—failed to present a report. At that meeting the Committee was re-

¹The terminal numerals in parenthesis are inserted for purposes of identification in the records of this *Journal*.—[Ed.]

constituted, and after Dr. Cooke's resignation a new chairman appointed, as follows: Drs. Harold W. Alden, David D. Bloom, Thomas J. Giblin, Harold A. Kent, Leroy M. S. Miner, William V. Ryder (*chairman*), David F. Spinney. The Association voted "that the report [of this Committee] be published in the [*Harvard Dental Alumni*] *Bulletin* in sufficient time to allow action at the Spring Meeting." Later it was decided to restrict this meeting to clinics. The prospective report will be considered at the meeting to be held on June 10, 1942.—[*C. Ed.* (3)].

"TIME" MAGAZINE AGAIN MISREPRESENTS DENTAL NEWS

In your issue for December, 1941, there was a reference, on page 313, to "three personal misrepresentations" in a recent article in *Time*, "the weekly newsmagazine," about dentistry. The article quoted below, from the issue of *Time* for March 30, 1942, is a further illustration of *Time's* tendency to misrepresent dental news:

"Teeth Straighteners"

"Every year 300,000 youngsters go through the painful and costly ordeal of having their crooked teeth clamped into braces to be straightened. Last week in New Orleans the men who make the braces, the Inter-American Orthodontic Congress, met to discuss new ways of clamping down on unruly young teeth.

"It may be heredity, bad nutrition, lack of care or accident that is the reason many children's teeth gap widely or fail to connect when they close their jaws. This condition is called malocclusion; it is the orthodontists' favorite word and their chief problem.

"Classic technique of oldtime tooth straightening was to bring the teeth into line by main force, with heavy plates or bands that pressured them gradually forward or back. The bands, tightened once or twice a week, stayed on for painful years. More recent methods use thin wires which are passed through light bands cemented to individual teeth, giving a gentler pressure.

"Hopeful new development in orthodontics, from the patients' point of view, is a radical treatment of some forms of malocclusion worked out at Yale Medical School by Dr. Bert George Anderson. By building up a complicated engineering structure of small bands, spurs and wire in the mouth, Dr. Anderson brings both teeth and jaws into alignment. His rig makes talking and eating a little difficult, but he leaves it in place for only a short

time. From two days' to two weeks' application, he claims, brings teeth into line as perfectly as uncomfortable months of the older methods."

The misrepresentation in the foregoing article, to say nothing of its ridiculous superficiality, is revealed by these matters of fact: *Dr. Anderson was not on the program of the said Inter-American Orthodontic Congress. No mention was made of his previously published paper by anyone on the program—(4).*

Comment. We have received the following additional information. A local New Orleans reporter interviewed, for about two hours, a group of orthodontists at the Orthodontic Congress regarding the outstanding features of the program, stating that his notes would be forwarded to *Time* magazine. Evidently it seemed appropriate to the management of *Time* to import and adjust the allusion to Dr. Anderson's "radical treatment" in a way to create the impression that that treatment had been considered at, and was a distinguishing and approved feature of, the recent Orthodontic Congress. There is widespread disapproval among orthodontists generally of the "radical treatment" proposed by Dr. Anderson, on the ground that it is an unscientific, inadequate, and unnecessarily painful procedure.—[*C. Ed.* (4)].

THE CHANGE IS NEEDED NOW!

A correspondent has sent us the comments of an experienced dental officer (not stating whether of the Army Dental Corps or of the Navy Dental Corps) concerning certain matters in the issue of the *JOURNAL OF THE AMERICAN COLLEGE OF DENTISTS* for March, 1942. The officer spoke glowingly of the staunch position consistently taken by Doctor Gies in regard to the appropriateness of autonomy for the dental profession (see pages 8 and 85 of the same issue, for example). He stated his observation that anywhere in the world that our profession is subordinated to and controlled by the medical profession it is inexorably *reduced* to the *medical* IDEA of what the dental profession amounts to or should amount to. He remarked that everywhere the medical profession insists on autonomy for *itself*. Nowhere is this better exemplified than in the Army and Navy, where the medical officers demand *and* GET full

control of medical affairs. The combatant officers dare not dictate nor interfere, even if they were so inclined. Medical officers are very jealous of their rights and prerogatives, and are quick to make a "command" out of any sort of medical establishment. But as they insist on autonomy for themselves in medical matters, they deny it to dental officers in dental matters. (What is that famous quotation which is about as follows: "When *you* are in power, I shall *demand* for myself that fairness of treatment which I shall deny to you when *I* am in control.")

The officer went on to remark about "Colonel" Messner having managed excellently the dental matters of the Public Health Service up to the time of his death. But advantage was taken of Messner's death to break up the dental organization by dividing it into sections, each assigned to and submerged in a medical division. There was an impression that one or more Public Health physicians expressed dissatisfaction, at that time, over the control Messner had had over his *own professional* matters!

The officer remarked that the opinion expressed following the caption, "U. S. Public Health Service" (page 96), was considered appropriate except that wonderment was shown as to why it was not written, in the last line, "working *with* the (M.D.) Surgeon General" rather than "*under*." Various bodies, or representatives thereof in this country, work *with* other bodies or their representatives without being *subordinated* to them. That is the true American method. The various services of the Army work *with* one another without being subordinated one to another (unless one thinks of the Dental Corps as a Service, being completely subordinated to the Medical Corps).

The officer expressed great astonishment over the statements appearing in the lower half of page 96. The Army and the Navy exist *for* war, and their respective Dental Corps exist to help in the prosecution of any war by rendering those services for the troops which no other officers are qualified to render. The country is *now* at war. The important change of putting dental officers in charge of dental matters *should* have been made long ago—before war befell us—in order that the Dental Corps could have made better

contributions to preparations for war. But it is utterly fallacious to contend that such an improvement should *not* be made at the earliest possible moment (immediately being none too soon). Advocating that the improvement be deferred until *after* the war is indeed beside the mark! The officer seemed considerably stirred by this, and was understood to say something about instances of adequate means for caring for the mouths of men currently being delayed for weeks or months, or barred altogether, owing to the vagaries of medical minds controlling dental matters.

Then attention was called to the drastic changes being made right now in the organization of the War and Navy Departments, and to the changes in the armies and fleets. It is the *usual* procedure to make such changes *during* time of war. *Then* it is the case of getting the *best* for the good of the Army and the Navy. When the war is over subordination is more endurable, and it matters less to put up with the effects of jealousies and prejudices. The time to effect changes for the good of the Army and Navy is *now*. Give Army and Navy dental officers charge of dental matters as complete as that given to officers of the most autonomous corps in its own matters! *Do so at once!*—(5).

Comment. The terminal comment on page 96 of our issue for March, 1942, was based on the assumption that current war conditions might make desirable changes untimely, if attempted now. The foregoing statement by an "experienced dental officer" convinces us that "the change is needed *now*."

The facts in the first paragraph of the foregoing statement by an "experienced dental officer" lead us to suggest that the succeeding note, on the "proposed degradation of dentists in a medico-dental society," presents "more of the same."—[C. Ed. (5)].

PROPOSED DEGRADATION OF DENTISTS IN A MEDICO-DENTAL SOCIETY

On May 1, 1942, the Board of Governors of the International Anesthesia Research Society issued, to the members of the Society, a circular letter which was accompanied by enclosures, including "a copy of the new Constitution and By-laws which were drafted and

presented to the members attending the Twentieth Annual Congress of Anesthetists," November 3-6, 1941. The members consist of approximately 2200 physicians, 1000 dentists, and 100 research workers. The said circular letter included the following comment in appealing for votes to assure adoption of the proposed new Constitution and By-laws: "It is highly *important that you vote* in order that your holdings will be protected and the Society perpetuated."

At present the dental members of the International Anesthesia Research Society are included among the *active* members—for the last twenty-one years they have had the same privileges in the Society as the medical members—and, as such, have "holdings," rights and obligations, equal to those of any other active members. But the proposed new constitution would disfranchise the dental members by reclassifying the membership into three groups, as follows (*italic not in original*):

"(1) Active voting members are to be *licensed physicians* and paying \$12.00 a year.

"(2) Associate members are to be *dentists* without voting privileges and paying \$10.00 a year.

"(3) Honorary members are to be research workers with doctorates in science or with equal qualification."

The said circular letter also indicates that each of the officers (3) and Board of Governors (6), elected at the final session of the meeting referred to above, is a physician—*no dentist was included*.

Among the objects of this Society, as stated in the proposed new constitution, are these (*italic not in original*):

"(2) To encourage and promote the practice of Anesthesiology by the medical and *dental* professions.

"(3) To encourage the teaching and study of anesthesia in the medical and *dental* schools, colleges and hospitals.

"(5) To sponsor, maintain and *govern* the International College of Anesthetists [Fellows of which have the title: "F.I.C.A."].

"(6) To sponsor, maintain and *direct* the Annual Congress of Anesthetists."

One of the dental members, several days after the issuance on May 1 of the said circular letter, sent, to the Board of Governors

of the International Anesthesia Research Society and to other officers, a letter setting forth in part as follows some of the objections to the proposed degradation of the dental members:

"I was very much grieved to receive the ballot which concerns the proposed change of the constitution of the International Anesthesia Research Society and note that Article 3, if passed, would disfranchise the 1000 dental members of this Society.

"What purpose, may I ask, would this unfair disfranchisement serve? You are well aware that the dental profession has long been active in anesthesia. As you may recall:

"(1) The A.M.A. in 1870 voted that Horace Wells, a dentist, was the discoverer of anesthesia.

"(2) Wm. T. G. Morton, a dentist, first demonstrated ether anesthesia and was the first specialist in anesthesia, also the first manufacturer of anesthesia apparatus.

"(3) [H. J.] Carlson, a dentist, introduced ethyl chloride as an anesthetic.

"(4) [C. K.] Teter and [J. A.] Heidbrink, dentists, were early manufacturers of nitrous oxide anesthesia apparatus and did much educational work.

"(5) Local anesthesia became popular with the medical profession as a result of its widespread use in dentistry.

"(6) The dental sections at all meetings of the Society have had the largest attendance of any sessions held during the meetings.

"It seems to [be undesirable] . . . to interject, at a time like this, an issue which is bound to cause considerable resentment in the dental profession against the medical profession. This is a time for national unity, a time when we all need to pull together, not a time for the various health services to war among themselves. I can assure you that the dental members are true Americans and will fight just as vigorously for their rights as did that pioneer dentist, Paul Revere."

One of the leading non-medical members of the Society, in the group of "research workers"—expressing objection to the proposed disfranchisement—has written:

. . . "It seems to me to be fully unjustified for the International Anesthesia Research Society to take any action that would disfranchise dental members of the Society. Dentistry has contributed enormously to anesthesia and it is most important that members of the dental profession maintain an active interest in the theoretical and practical problems of anesthesia. I am confident that the dentists have much to contribute and I will do everything

possible to prevent any interference with their participation in anesthesia research and to prevent any reduction in their interest in support of the field. You may use these comments as you wish."

This proposed disfranchisement has far-reaching possibilities of injury not only to the dental profession but also to the public. In most of the hospitals giving dental service in this country, the dental staffs have been accorded the same status as the medical, with equal voting privileges. Dentists have the legal right to administer any and all kinds of anesthetics. Dentists administer anesthetics in hospitals which have the Certificate of Approval of the American College of Surgeons. Why the amendment for the disfranchisement of dentists was proposed, and what benefits are expected to accrue to the Association from its adoption, have not been indicated in any official statement to the members. Adoption of the said amendment, disfranchising the dental members of the International Anesthesia Research Society, would obviously establish a precedent to reduce unjustly the standing of dentists not only in hospitals but also in other health-service relationships.—(6).

Comment. The following related additional information has been received: Although about 500 dental members attended the scientific sessions of the Congress, very few dental members were present at the concluding business session on November 5, when the new constitution was brought "before the house" for consideration. Before the meeting each member received a printed copy of the new constitution as proposed provisionally at the annual Congress held the year before. This form, which did not contain the disfranchisement plan, was generally regarded as satisfactory. But at the concluding business session—without any previous announcement of what was afoot—the disfranchisement plan, proposed by medical members, was inserted. Fortunately, amendments must be submitted to a vote of the entire membership. This vote is now being taken, the poll remaining open from May 1 to August 1, 1942. At least two-thirds of the total membership must participate in the ballot, and there must be an affirmative two-thirds majority of the recorded votes, for adoption of an amendment (by addition or substitution).

Those who are familiar with the inclination of many physicians to withhold from dentists and dentistry some ordinary courtesies—shown again by this disfranchisement proposal—will not be surprised to learn that the *International Directory of Anesthetists* for 1942 (published annually by the International Anesthesia Research Society) arranges the lists of members in the United States in this *artificial* sequence: "Medical" (48 pages, 2025 persons); "Surgical" (5 pages, 174 persons); "Research" (3½ pages, 96 persons); "Dental" (23 pages, 1011 persons).

For additional recent evidence of conditions that are designedly derogatory to dentistry see the preceding statement under the heading, "The change is needed now;" also the units following the subheadings, "Unbounded enthusiasm for dental health-care" and "Wonderful 'modern development in education,'" on pages 97 and 98 in our issue for March, 1942.—[C. Ed. (6)].

NOTES

DENTISTRY: GENERAL DEFINITION AND CONTRASTS

The following views are presented to stimulate constructive thinking. Suggested improvements of these statements are invited for publication and discussion.

General definition. Dentistry is the natural division of health service that includes the prevention, diagnosis and treatment of disorders of the teeth and supporting tissues, and also the related reconstruction, restoration or substitution of lost or removed parts of teeth, for the maintenance of dental functions. Dentistry is based not only upon (a) the physical and biological sciences that are fundamental for all types of health service, but also upon (b) the sciences that are basic for all types of mechanical arts; and it (c) exemplifies special phases of esthetics and phonetics. Dental practice includes recognition of, and consultation with physicians on, the mutual relationships of various oral and systemic conditions and disorders as causes or sequelae—and also the ensuing *interdependent* services (dental, medical), advisory or practical, for the individual patient. Dentistry is unique in the fact that the hard parts of teeth, owing to the density and stability of the mineralogical constructions that enable teeth to perform their mechanical functions in the stresses of mastication, are *weak in or devoid of healing processes*. Therefore, treatment by the dentist, *to restore oral health*, must often—unlike most conditions in medical practice—circumvent rather than aid Nature; and accordingly much of the treatment must be performed with degrees of digital skill, mechanical exactness, and microscopic precision that are not equalled or required in other types of health service. These conditions collectively account for, and require continuance of, a specially adapted system of professional education for dentists.—[C. Ed. (9)].

Contrasts. For the *general practice of medicine*, the physician should understand many changes and interrelationships in all parts of an actively dynamic organism undergoing rapid alterations. His

health service—whether preventive or remedial—consists chiefly of interpretations of the said phenomena, and of directions to the patient or others as to what in the main should be done. He should *know much about very many* biological conditions, but himself *needs to do little* about any of them for the individual patient.

For the *general practice of dentistry*, the dentist should understand the comparatively small number of changes and interrelationships that affect several tissues, which are mainly static and only slowly undergo comparatively few alterations. His health service—whether preventive or remedial—consists chiefly of interpretations of these phenomena, and of himself accomplishing for the patient much of what should be done directly. He should *know much about relatively few* biological conditions, and himself *must do most* about practically all of them for the individual patient.

The foregoing contrasts ignore the obvious: that the greater the understanding by the practitioner about the largest number of realities affecting the patient, and the greater the practitioner's efficiency in according these realities of a patient's condition the attention they may require, the greater the degree of comprehensive health service the patient may receive—which can be attained in its highest degree only by cooperation among medical and dental practitioners in any instance beyond their individual capabilities.—[C. Ed. (10)].

MILITARY DENTISTRY: CIVIL WAR STYLE

Mark Twain, in his *A Tramp Abroad*, delved into many interesting by-paths as he and his agent, a Mr. Harris, rambled through certain sections of Germany and Switzerland. During one of their hikes in the Black Forest district of Germany, the conversation drifted to dentistry—to quote Twain:

"That changed the subject to dentistry. I said I believed that the average man dreaded tooth-pulling more than amputation, and that he would yell quicker under the former operation than he would under the latter. The philosopher Harris said that the average man would not yell in either case if he had an audience. Then he continued:

" 'When our brigade first went into camp on the Potomac, we used to be brought up standing, occasionally, by an ear-splitting howl of anguish. That meant that a soldier was getting a tooth pulled in a tent. But the surgeons

soon changed that; they instituted open-air dentistry. There never was a howl afterwards—that is, from the man who was having the tooth pulled. At the daily dental hour there would always be about five hundred soldiers gathered together in the neighborhood of that dental chair waiting to see the performance—and help; and the moment the surgeon took a grip on the candidate's tooth and began to lift, every one of those five hundred rascals would clap his hand to his jaw and begin to hop around on one leg and howl with all the lungs he had! It was enough to raise your hair to hear that variegated and enormous unanimous caterwaul burst out! With so big and so derisive an audience as that, a sufferer wouldn't emit a sound though you pulled his head off. The surgeons said that pretty often a patient was compelled to laugh, in the midst of his pangs, but that they had never caught one crying out, after the open-air exhibition was instituted.' ”

(Mark Twain: *A Tramp Abroad*, Vol. I, pages 203-4; Harper and Brothers' Edition, 1907; P. F. Collier and Son, New York.)—*[C. Ed. (11)]*.

BOOK ANNOUNCEMENTS

Physical Properties of Dental Materials: For the first time a complete summary of the more than one hundred reports on research conducted in the dental laboratory at the National Bureau of Standards during the last twenty-two years has been compiled by the Bureau staff in cooperation with the Research Commission of the American Dental Association. This publication, designated Circular C-433, has just been issued.

The summary covers restorative and accessory materials such as amalgam, gold alloys, denture base resins, cements, investments and impression materials. Details of test methods, many of which were developed at the Bureau, including illustrations and descriptions of testing equipment, will be found of particular value to dental schools and research laboratories. The specifications of the Federal Government and of the Association are included in the book.

The active cooperation of the American Dental Association made possible the extension of the data accumulated at the Bureau to show more clearly their dental significance. In the circular, the data are quite often discussed under two headings, namely, theoretical significance and technical applications. The small amount of repetition necessary for this dual treatment may be excused since it makes possible the addressing of two groups of reader interests in one publication. Furthermore, the combining of these two phases of the research gives greater clarity and unification to what otherwise might appear to be masses of data on unrelated materials.

The dentist will find explanations for some of the many problems which confront him daily, such as excessive expansion (or shrinkage) of amalgam, shrinkage of gold inlays, solubility of cements, etc. He will find technics suggested which will eliminate or reduce these difficulties.

For students at dental schools, the book will be excellent as a text or as necessary reference material. Libraries, not having all of the individual publications, will find this volume the answer to their unsuccessful attempts to secure complete sets of the reports.

The publication appears under the joint authorship of Wilmer Souder, Ph.D., principal physicist of the National Bureau of Standards, and George C. Paffenbarger, D.D.S., research associate of the American Dental Association. The price is 75 cents. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Proceedings of the Second Congress on Dental Education and Licensure: As indicated in the title, this is a report of the second Congress on Dental Education and contains the addresses delivered and actions taken at that time. Published by the Council on Dental Education, American Dental Association, 212 East Superior Street, Chicago, Illinois.

Technical Manual for Dental Technicians: This manual, TM8-225, is published by the War Department and is intended for technicians—laboratory, radiography, hygienist and assistant—in the Army and Navy dental service. It is replete with information, counting nearly 200 pages and may be had for 40 cents by addressing Superintendent of Documents, Washington, D. C.

The W. K. Kellogg Foundation: The First Eleven Years: Under this title, a report of The W. K. Kellogg Foundation has just made its appearance. The achievement is told in text and picture, and altogether tells a splendid story of accomplishment.

Kellogg's breakfast foods are household names and their sales have made possible this splendid health project, including valuable assistance to the University of Michigan. All phases of the social life of the individual and of the community benefit through its ministrations and it stands to become an example for other communities, which might happen to be so fortunate as to be similarly favored. A copy of the report may be had by addressing The W. K. Kellogg Foundation, Battle Creek, Michigan.

ERRATA

An error occurred in the name of one publication in the report of the Committee on Journalism in the March issue of the JOURNAL, page 63 line 1. The name of the publication is "Archives of Clinical Oral Pathology."

OUR ADVERTISEMENTS

A policy intended to safeguard professional interests and to encourage the worthiest industrial endeavor

The basis and conditions of our policy relating to advertisements are set forth below (*J. Am. Col. Den.*, 2, 199; 1935):

I. Advancement of the material aspects of civilization is largely dependent upon the expanding production and distribution of commodities, and their correlation with individual needs and desires. Successful practice of modern dentistry, on a broad scale, would be impossible without an abundance of the useful products of dental industries. Leading dental manufacturers and dealers have been providing invaluable merchandise for the dental practitioner. The business of supplying dental commodities has been effectually organized and, as an auxiliary to oral health-service, is more than sufficient to tax the greatest ingenuity and all the attention and integrity of each dental producer and distributor.

The American College of Dentists aims, in the public interest, to strengthen all wholesome relations and activities that facilitate the development of dentistry and advance the welfare of the dental profession. The College commends all worthy endeavors to promote useful dental industries, and regards honorable business in dental merchandise as a respected assistant of the dental profession. Our Board of Editors has formulated "minimum requirements" for the acceptance of commercial advertisements of useful dental commodities (*J. Am. Col. Den.*, 2, 173; 1935). These "minimum requirements" are intended, by rigorous selection on a high level of business integrity and achievement, to create an accredited list of *Class-A dental products and services*, and include these specifications: Advertisements may state nothing that, by any reasonable interpretation, might mislead, deceive, or defraud the reader. Extravagant or inappropriate phraseology, disparagement, unfairness, triviality, and vulgarity must be excluded. Advertisements relating to drugs or cosmetics, foods, dental materials, education, finance—to any phase of interest or activity—will be accepted for only such commodities or services as merit the commendation, approval or acceptance of the National Bureau of Standards, American Dental Association, American Medical Association, Council on Dental Therapeutics, Dental Educational Council, Better Business Bureau, and other official bodies in their respective fields of authoritative pronouncement.

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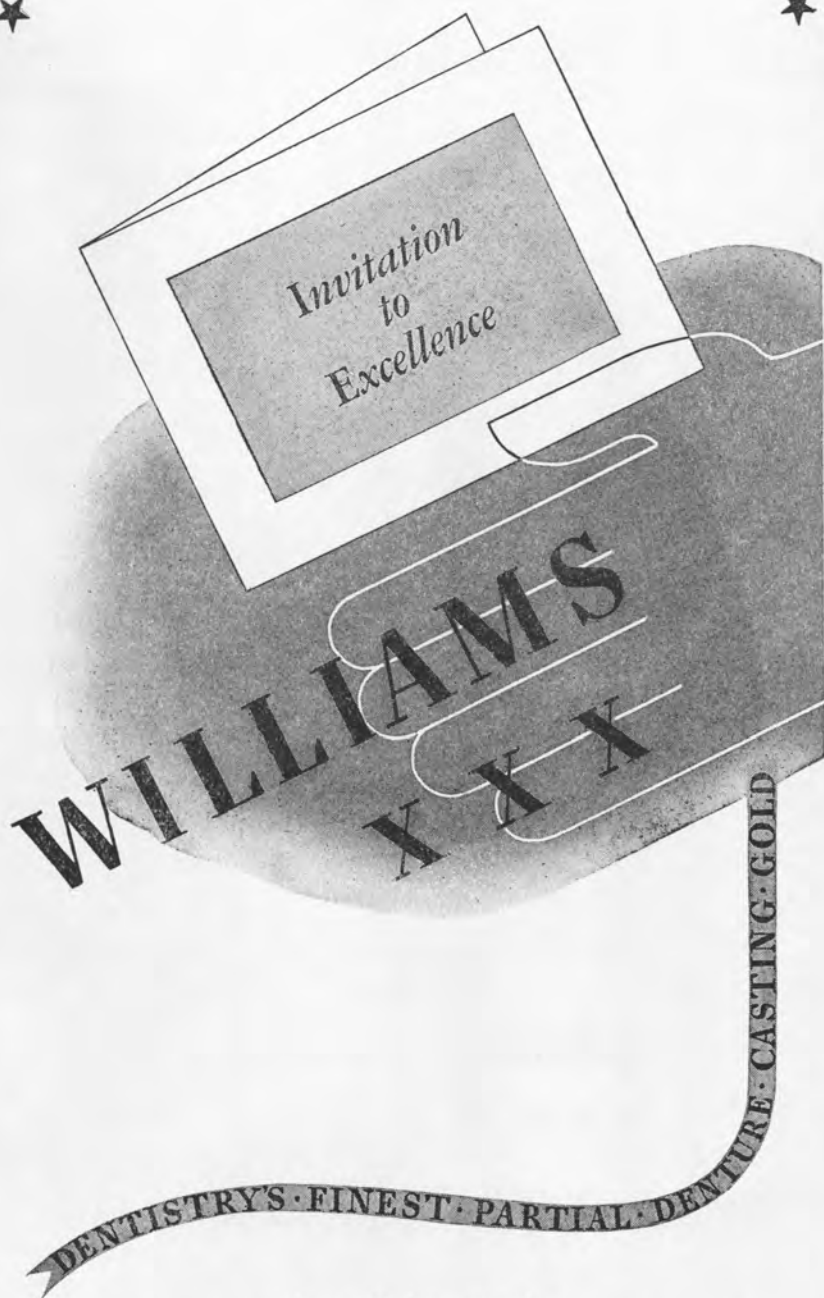
The welfare of the consumer is our paramount consideration. In accordance with the recommendation of the American Association of Dental Editors, the placement of advertisements will be restricted to the advertising section.

II. An advertisement, to be accepted or repeated, not only must conform with the said "minimum requirements," but also *must meet the special test applied through a questionnaire* that will be repeatedly exchanged confidentially with numerous referees in all parts of the United States, and which contains the following inquiries:

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III. The advertisers whose claims are published on the succeeding pages stand high in commercial character and on the recognized merits of their products (services, etc.). They are not among those who seek advantage from misrepresentation, and need no assistance from a prejudiced or insincere journalistic policy. They are above the temptation to try to control or influence any aspect of the conduct of this *Journal*, which in all its phases is completely independent, and fully representative of the professional ideals and the professional obligations of the American College of Dentists. We commend each advertiser in this issue to the patronage of all ethical dentists.

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Announcements

Next Annual Convocation: Boston, Mass., August 23, 1942.

Fellowships and awards in dental research. The American College of Dentists, at its annual meeting in 1937 [*J. Am. Col. Den.*, 4, 100; Sep. and 256, Dec., 1937] inaugurated plans to promote research in dentistry. These plans include grants of funds (The William John Gies Fellowships) to applicants, in support of projected investigations; and also the formal recognition, through annual awards (The William John Gies Awards), of distinguished achievement in dental research. A standing committee of the International Association for Dental Research will actively cooperate with the College in the furtherance of these plans. Applications for grants in aid of projected researches, and requests for information, may be sent to the Chairman of the Committee on Dental Research of the American College of Dentists, Dr. Albert L. Midgley, 1108 Union Trust Bldg., Providence, R. I. [See "The Gies Dental Research Fellowships and Awards for Achievement in Research," *J. Am. Col. Den.*, 5, 115; 1938, Sep.]

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