INTRODUCTION

A BRIEF review of what is known of the development of the human dentition and its chronology is indicated since such facts are useful in everyday dental practice.* The development of the teeth will be traced chronologically according to the successive developmental periods that characterize the growing individual, so that the development of the dentition and the individual as a whole can be correlated.

PRENATAL PERIOD

During the prenatal period, the crowns of the deciduous teeth grow and calcify within the jaws. The formation and calcification of enamel and dentin begin first in the central incisors, at about 4 1/2 to 5 months in utero, and proceed in fairly regular sequence in the adjacent teeth, the second deciduous molar beginning its formation at about 6 months in utero. (Fig. 1.)

Layers of enamel and dentin are deposited one upon another as shown in Figures 2 and 3, until the crown is completed and root formation begins.

The enamel and dentin formed during the prenatal period are of good quality, probably because of the favorable environment and nutrition of the developing fetus.

*From the Department of Histology, University of Illinois College of Dentistry.

**The American Dental Association gave special attention to this problem when it arranged a dental health lecture for ready access to the dental profession, entitled "Nature—Builder of Teeth," available in film or stereopticon form.

BIRTH (NEONATAL PERIOD)

At the time of birth, root formation has not yet started and the deciduous teeth are not yet erupted. Within the jaws, however, the crowns of the deciduous incisors are about five-sixths completed; the deciduous cuspids crowns are about half completed, and the cusps of the first deciduous molars are just completed and have coalesced, but the cusps of the deciduous second molars are only half formed and are still isolated.

The mesiobuccal cusp of the first permanent molar begins its formation at about the time of birth, but this is not often visible in the x-ray film because its calcification is still incipient. Chronologically and in its position in the arch, the first permanent molar is the last of the deciduous teeth. Functionally, however, it is a permanent tooth, and probably the most important one for the normal occlusion of the permanent denture. It is unfortunate that parents have mistaken this tooth for a deciduous one because of its position, its early formation and eruption, and have allowed decay to cause its loss, expecting its replacement by a successor.

The birth experience, with its concomitant trauma and neonatal adjustments to the new environment and mode of nutrition, produces a distinctly accentuated incremental ring within the enamel (band of Retzius) and dentin (Owen's line of contour) of these teeth, indicating the level of calcification at the time of birth. (Fig. 1.) These are called the neonatal rings and they are found in the deciduous teeth of all children.
Fig. 1.—Chart showing development of human dentition. (Available in 5 colors; 12 x 18 inches in size. Suitable for framing. 15 cents each. Bureau of Public Relations, American Dental Association.)
If the birth trauma has been excessive or the neonatal adjustment very difficult, an accentuation of the neonatal ring will occur in the form of an acute neonatal hypoplastic defect, which can be seen after the teeth have erupted.

*Infancy Period*

The early infancy period (birth to 6 months of age) is characterized by the beginning of growth and calcification of cuspid. The upper lateral incisor, the exception to the rule, begins to form at 10 to 11 months of age. (Fig. 1.) Hypoplasia due to metabolic disturbances occurring during the early infancy period, therefore, misses the upper lateral incisor. This fact is useful in establishing clinically the chronologic incidence of enamel hypoplasia. (Figs. 4 and 5.)

The first year of life is a period of postnatal adjustment for the developing

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**Fig. 2.** Incremental pattern of growth of enamel and dentin in incisor tooth.

**Fig. 3.** Incremental pattern of growth of enamel and dentin in molar tooth.

the permanent first molars and all the anterior teeth with the exception of the upper lateral incisors. (Fig. 1.)

The first permanent molar is the first of the permanent teeth to develop. It begins to form and calcify at birth. The permanent anterior teeth begin their formation at from 4 to 6 months of age in regular order from central incisor to infant and, in many respects, is a continuation of the neonatal (new-born) adjustment period. Difficulties in accommodation of the gastro-intestinal tract to the new form of nourishment results in the difficulties of feeding and in the nutritional upsets of infancy. The metabolic disturbances that result may cause hypoplastic defects in the enamel
of the teeth forming at that time—that is, the first permanent molars and the permanent anterior teeth—but may miss the upper lateral incisors because the latter begin formation at the end of the infancy period. About three-fourths of the total number of cases of enamel hypoplasia develop during this period. The defects can be seen clinically only after the permanent teeth erupt (after the sixth year), or before that time in intra-oral x-ray films. (Figs. 4 and 5.) No amount of dietary regulation or calcium therapy will ever correct these enamel defects once they occur.

The late infancy period (6 months to about 1 year of age) is characterized by the eruption of the deciduous incisors into the oral cavity.

During the previous period, the crowns and roots of the deciduous teeth have continued to grow and calcify preparatory to their eruption into the oral cavity. Teeth are not necessary during early infancy because the diet is essentially milk. This period, therefore, is often called the period of lactation. However, supplementary feedings usually begin during the second half of the first year of life. At the same time, the deciduous teeth begin to appear in the oral cavity as if in response to a need.

The deciduous central incisors usually appear in the oral cavity at about the seventh month, the lower before the upper, and are soon followed by the lateral incisors. The first deciduous molars appear next, toward the end of the first year. Usually, as in the permanent dentition, the cusps erupt after the first premolar tooth and are guided into position by the adjacent teeth already present.

A simple method of remembering the time and order of eruption of the deciduous teeth is shown in Table 1.

**CHILDHOOD PERIOD**

The preschool age, between the second and the sixth year of life, is usually called the childhood period. It is characterized by:

1. The presence of the complete deciduous dentition within the oral cavity.
2. The functional attrition or physiologic wear of these deciduous teeth.
3. The gradual resorption of the roots of the deciduous teeth.
4. The continued growth and calcification of the crowns and roots of the permanent first molar and anterior teeth. At the beginning of the second year, also, the permanent bicuspids and second molars begin to grow and calcify.

In the meantime, the permanent anterior teeth are developing, and with their development the jaw is growing. As a result, and to accommodate the larger, permanent successors, the deciduous anterior teeth usually become spaced at the fourth or fifth year (physiologic spacing of the deciduous anterior teeth). (Fig. 7.)

Concomitantly with the growth and intra-osseous eruption of the permanent teeth, the roots of the deciduous teeth become resorbed.

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<tr>
<th>Table 1.—Time and Order of Eruption of Deciduous Teeth</th>
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<td>Upper teeth</td>
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<td>Lower teeth</td>
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<td>Months</td>
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Fig. 6.—Frontal roentgenograms at 6½, 8, 9, 10, 11 and 12 years in case shown in Figure 5, indicating change in inclination of all incisors and cuspids, and path of eruption. D, "Ugly Duckling" stage. (Broadbent, B. H.: Face of Normal Child. Angle Orthodontist, 7:189-209, October 1937.)

5. The beginning of the growth and calcification of the crowns of the permanent bicuspids and second molars. (Fig. 5.) By the end of the second year, all the deciduous teeth have erupted and are in functional occlusion. Continued function plus a more solid diet produces a functional wearing or attrition of these teeth.

EARLY GRADE-SCHOOL PERIOD

The grade-school period, from 6 to 12 years of age, is characterized by the resorption and shedding of the deciduous teeth and the eruption of the permanent dentition. It is therefore often called the period of mixed dentition.

The grade-school period is divisible into two parts: the early grade-school period, from 6 to 10 years of age, and
the prepuberal period, from 10 to 12 years of age.

The early grade-school period begins with the eruption of the first permanent molar, at the sixth year of age. It is soon followed by the appearance of the incisors, at from 7 to 8 years of age. Usually the incisors precede the upper in eruption. (Fig. 7.)

The incisors do not usually appear in the oral cavity in alignment. The teeth are often staggered so that the lateral incisors lie lingually from the central incisors and the upper central incisors are often spaced (physiologic spacing of per-

![Intra-oral photographs showing normal transition from deciduous to permanent dentition in anterior part of mouth. A, at about 4½ years, showing spacing of anterior deciduous teeth. B, at about 6½ years, showing loss of upper deciduous central incisors and eruption of lower permanent central incisors. C, at about 7 years; eruption of permanent lower lateral and upper central incisors, showing spacing and inclination of upper central incisors. D, at about 8 years; eruption of permanent upper lateral incisor and beginning of closure of central diastema. E, at about 10 years; further eruption of upper lateral incisors and closing of central diastema. F, at about 11½ years, eruption of permanent cuspids, showing correction in inclination of incisor teeth. The ages given are average and may vary considerably under different local as well as systemic conditions. Girls are generally ahead of boys in tooth eruption. Closure of the central diastema may not occur until the eruption of the cuspids.

ally, the teeth appear in the oral cavity earlier in the female than in the male. Characteristically also, the lower teeth

permanent upper incisor teeth). (Figs. 6 and 7.) However, with the continued growth of the jaws, and under the action
of the tongue and the labial musculature, the teeth tend to become aligned. With the eruption of the cuspsids, the spacing of the central incisors tends to become corrected. (Fig. 7.) This transitional stage of the dentition has been aptly termed by Broadbent the "Ugly Duckling Stage."

Malocclusion in the anterior segment of the arch often has its beginning at this time. For example, a scissored bite in which one or both of the upper incisors are trapped lingually from the lower incisors has its inception at this age. Correction is simple at this time, but more difficult at later age periods. In a similar manner, abnormal spacing of the anterior teeth, lingual version of the lateral incisors and other malpositions arise at this age.

PREFUBERAL PERIOD

There is a pause of about 1 to 2 years before the appearance of the next tooth and the beginning of the prepuberal period, at 10 years of age, marking a lag in the eruption of the cuspids similar to the one seen in the deciduous dentition. The first bicuspids, like the first deciduous molar, usually precede the cuspids.

The first bicuspids usually erupt at 10 years of age. They are followed by the second bicuspids and the cuspids, at 11 to 12 years. (Fig. 1.) The eruption of the cuspids between the lateral incisors and the first bicuspids forces the incisor teeth into correct alignment and axial inclination, and thus closes the space between the central incisors. (Figs. 6 and 7.) The first bicuspids thus act as a buttress for the erupting cuspids. The order of eruption is therefore far more important than the chronologic age of the child. The actual age at eruption of any of the teeth is quite variable, depending upon race, sex, type and systemic as well as local conditions.

If, for any reason, such as premature loss of the deciduous cuspids or the prolonged retention of the deciduous cuspids, the space between the first bicuspids and the lateral incisor is insufficient to accommodate it, the cuspids will be forced into a position labially from the arch.

The eruption of the second bicuspids is soon followed by the eruption of the permanent second molar, at 12 years of age.

The prepuberal period is thus characterized by completion of the permanent dentition (except for the third molar) and the transition from the Ugly Duckling to a mature stage of dentition. This is correlative with maturation of the child as a whole. During the prepuberal period, the child tends to lose the roundness of childhood and advances noticeably toward adolescence.

It should be noted that eruption of the first permanent molar, at the sixth year, marks the beginning of the mixed dentitional period, and eruption of the second permanent molar, at the twelfth year, marks the end of this period. It is well to remember that the appearance of the first permanent molar begins and appearance of the second permanent molar ends the mixed dentition period. The appearance of the other permanent teeth occurs in fairly regular sequence and at yearly intervals except for the cuspids. The central incisors appear at about 7 years, the lateral incisors at about 8 years. But there then follows a pause of about one year, and the next tooth to erupt is the first bicuspids, at 10 years. The cuspids and second bicuspids then erupt, at about 11 to 12 years, and the period is terminated by the appearance of the 12-year molar. The sequence and chronology of eruption are shown in Table 2.

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<thead>
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<tbody>
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The lower teeth tend to appear earlier than the upper teeth. In addition, it is well to remember that in females the teeth tend to erupt earlier than in males, and that race, type, nutrition and the state of health, as well as mechanical conditions, cause marked variation in the time of eruption of the teeth.

The entire mixed dentition period is a critical one and should be carefully watched as regards possible beginning of malocclusion. Since the denture is in a state of flux, premature extractions or prolonged retention of deciduous teeth, abnormal habits of the tongue and labial musculature, nail biting and other conditions may initiate widespread malocclusion. Accidents which at any other period might be considered minor have profound effects if they occur during this dynamic stage of transition from one dentition to the other.

**ADULTHOOD**

The permanent dentition (except for the third molar) is completed by the time the adolescent period is reached (12-15 years of age). The third molar (whose formation and eruption are quite variable) erupts into the oral cavity during the young adult period (15-21 years). At the same time, physiologic attrition of the crowns and secondary cementum formation on the roots begin, becoming quite evident by the time adulthood is reached. (Fig. 1.)

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**NEBRASKA HOLDS POSTGRADUATE COURSE IN CHILDREN'S DENTISTRY**

The Nebraska State Department of Health, through the Division of Maternal and Child Health, in cooperation with the Nebraska State Dental Association and its affiliated groups, held six postgraduate courses in children's dentistry in late April and early May.

The locations of the meeting places were carefully selected in order to make it as convenient as possible for the dentists.

Charles A. Sweet, of Oakland, Calif., dean of Children's Dentistry, conducted the courses, and his practical presentation was greatly appreciated by those in attendance. The afternoon and evening programs were as follows:

**PROGRAM**

**Afternoon Session**

2:00 Announcements and introduction

2:30-3:30 A. Child Management

B. Office Management

3:30-4:30 A. Treatment of Fractured Anterior Teeth

4:30-5:30 A. Treatment of Non-Vital Deciduous Teeth

6:00 Dinner

**Evening Session**

7:30 A. Treatment of Deciduous Teeth with Exposed Pulps

B. Cavity Preparation for Deciduous Teeth

C. Sterilization of the Cavity and Filling Material