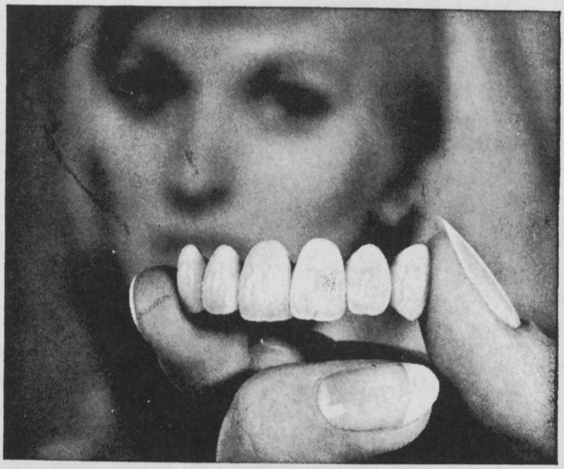

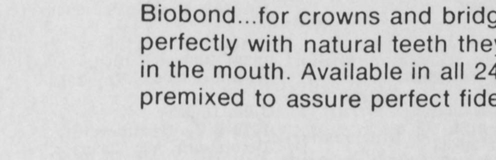
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COVER

The Tower of London

The Tower of London was built by William the Conqueror to guard the river approaches to the city, and though attacked many times in its long life as a fortress, it was never captured. It has also been used as a royal palace and as a state prison—Sir Walter Raleigh was kept here for thirteen years and spent his time studying chemistry and history. Among those beheaded on Tower Green were Ann Boleyn and Catherine Howard, two of the wives of Henry VIII; and Lady Jane Grey, who was Queen of England for nine days in 1553. The Crown Jewels are kept at the Tower.

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GUEST EDITORIAL

SO THAT WE MAY LEARN

Mayer G. Levy
Associate Editor

Who among us has an alternative to continuing postgraduate education?

The rapid expansion of dental knowledge is continuous and so must be the dissemination of this information. New mechanisms as teaching media are regularly developed, yet only 13%-15% of the dentists in this country avail themselves of regular continuing education.

Who among us can deny the professional need for continuing postgraduate education?

Surely, dental patients have as much right to modern dental therapy as dentists have the responsibility to practice to the best of their abilities. Consumer concerns no longer wait.

Since 1969, thirteen states have instituted continuing education requirements on a society or examining board level. Now is the time for the dentists of Virginia to assume this responsibility for the protection of the profession and of the patients. Now is the time for the dentists of Virginia to establish firm incentives for continuing postgraduate education so that we may learn, record our interest, and provide for our patients who depend on our knowledge.

Now is the time.

PREVENTIVE DENTISTRY—NEW CONCEPTS

ELEMENTARY SCHOOL DENTAL HEALTH PROGRAMS

by H. Gordon Cheney, D.D.S., M.P.H.
Chairman, Department of General and Preventive Dentistry
VCU-MCV, School of Dentistry

Tommy Thomas from Metropolitan, Virginia, and Janie Jones of Rural, Virginia, both have been exposed to dentistry for the first time in their lives this year—and they like it. About three years ago a few pilot programs on preventive dental health education were started in elementary schools across the United States. Since then many others have been started and currently there are programs in the cities of Newport News, Roanoke, Hopewell, Front Royal, Richmond and many other locales around the State of Virginia. Through such programs as these in Virginia, a vast number of third-grade children are being exposed to dentistry and actively participating in programs that will help them to achieve better oral health.

In this country only a small percentage of children receive preventive dental services and over 50 percent of the school children at age six have never been to see a dentist. It does not seem feasible to attempt to bring all of these children to the existing dental offices; therefore, another method was deemed necessary. That plan was to introduce a totally new dental health program to children in familiar surroundings to them—their schools. It was felt that the school setting was the best place for this new dental education program because it was conducive to learning and peer group reinforcement; it was the most central area where all children could become dentally informed; develop their own personal hygiene and learn the role that the dentist plays in preserving teeth; and the children could act as carriers in transporting information about dentistry to others in their family.

These preventive dental health programs impart dental health information to children and let them actively learn techniques to prevent dental disease. The method by which these programs are taught emphasize the "why" rather than just "how to" in the approach to controlling dental disease. Lackey (J. Cal. Dent. Assoc., Feb. 1974) showed that just giving a child a toothbrush and showing the method of brushing one's teeth has little or no value. The author said that an effective school dental health program must first supply the "why's" and then the "how to's" could be added.

These public school dental programs try to accomplish four objectives:

1. They create awareness about dental health.
2. They develop values of the importance of good oral health.
3. They begin to build life-long oral health habits.
4. They develop psycho-motor skills in plaque control.

Masters (J. Am. Soc. Prev. Dent., July Aug. 1972) has reported short-term success in these dental school programs. Also preliminary results from some of the programs in Virginia have shown encouraging results.

Through these dental health education programs in the school systems, the Tommies and Janies of tomorrow will enter dental offices with cleaner teeth, be more knowledgeable about dentistry and be motivated toward better dental health.

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The Virginia Dental Association is pleased to announce the implementation of its dental placement program entitled "Opportunities in Dental Practice." This service has been established to function as a clearinghouse for information relating to auxiliary employment, establishing or purchasing a dental practice, and to locating other dental employment opportunities.

This service extends placement referral services to all categories of dental personnel: dentists, dental hygienists, dental assistants, dental laboratory technicians, and other dental personnel. Communities or health care institutions with salaried openings or other practice opportunities for dentists may also use the system to locate professional personnel.

Using forms available through the Virginia Dental Association office, dentists, auxiliaries, dental lab managers, and community "dental recruitment" committees are able to initiate computer searches which result in current listings of dental manpower, available practices or other employment opportunities which correspond to their particular needs. After listings are initially entered, periodic updates are sent concerning new openings in the designated areas.

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VIRGINIA RESIDENTS GIVEN PRIORITY IN ADMISSION TO DENTAL SCHOOL

(Statement made before the Committee on Education and Health of the Senate of Virginia on February 7, 1974, by John A. DiBiaggio, Dean, VCU-MCV School of Dentistry)

Mr. Chairman, I appreciate the opportunity to appear before this Committee to testify regarding Senate Bills 95 and 198.

I am certain that all the deans of graduate and professional schools in Virginia would agree with the spirit of these laws as proposed by Senator Fears, since we all appreciate that our primary mission as state institutions is to produce qualified professionals for our State. Furthermore, we all realize that other factors are as important as grade point average in determining the potential candidacy of an applicant. However, we are very much concerned that the proposing of these laws could imply to some citizens that the professional and graduate schools of this State are not currently responding in a manner that is acceptable to both the Legislature and the people of this Commonwealth. Therefore, I feel that it is imperative that I point out the activities of our School of Dentistry, since I believe they reflect the activities of all of the professional and graduate schools in the State.

When I arrived at the Medical College of Virginia, Virginia Commonwealth University in 1970, I found that only 59 of the 100 students that were to matriculate in the Fall of 1970 were Virginians. This was very disturbing to me, in that I appreciated that Virginia had a very critical need for dental manpower, particularly in its rural areas. I learned that there were nine counties in Virginia that did not have a dentist, that another five counties with populations over 10,000 had only one dentist, and that still another eighteen counties with populations between 5 and 10,000 had only one dentist. In many of these instances, the dentist was elderly and near retirement. Therefore, the situation would be aggravated even further in coming years. In order to respond to this problem, the School of Dentistry began an intensive recruiting campaign for Virginia applicants. By the Fall of 1972, the entering class had developed an entirely different configuration. Of 110 students admitted in 1972, 95 were Virginians. This statistic was repeated in the Fall of 1973. In other words, the admitting class in two years had grown from 59 percent Virginians to 86 percent Virginians.

We also appreciated that the School must attract larger numbers of students from rural backgrounds. The class admitted in the Fall of 1970 was made up of only 16 percent students from rural communities. By the Fall of 1973, that figure had grown to 33 percent. This was accomplished through an altered system of evaluating the potential of students from rural areas. We knew that a student who came from a rural background probably did not have the same academic opportunities while in high school as did his counterpart in the affluent white suburbs of our urban areas. Therefore, in undergraduate school, he would predictably show a poorer performance than his urban counterpart in his first year. If he had potential, however, his second year would show marked improvement. His third year would be even better, and in his fourth year he would be a proverbial "house afire." We took a chance on exactly those kinds of students, and our success with them has been enormous. Conversely, those students who were "A" quality in their first year and deteriorated throughout their four years were candidates for rejection, even though their overall honor point might appear more competitive. We did, in effect, reject some students in this past year who had "B" averages and accepted some who had less than "B" averages who fell into the former group described.

Finally, we were very much concerned about the retention of those students that were admitted. We appreciated that a student who came to us with an academically marginal record would need a great deal of individual attention. This we provided through tutorial assistance, self-study aids, and other such mechanisms. I am pleased to announce that we have been able to reduce attrition from the ten percent that existed prior to 1970 to only two percent in the past two years. Thus, we have been able to graduate students of the quality and the competency that all of you would desire, while still being able to accept students whose academic record was somewhat weak. However, it should be appreciated that this type of individualized instruction requires an enormous amount of effort on the part of faculty and, therefore, it tends to be very expensive. At this time, when the State of Virginia faces a minor financial crisis, it would seem inadvisable to accept larger numbers of students who would impose even greater costs for professional education on our taxpayers.

I am very pleased that all this has been done without coercion or mandate from either you as members of the Legislature or from the federal government. In my opinion, that is exactly as it should be done in a democracy.

I thank you for the opportunity of having appeared before you.

The Evolution of Dentitions

by J. W. Osborn

The study of evolution suggests how the development of mammalian dentitions may be controlled

Because teeth contain the most durable of biological tissues they have left the best, albeit patchily distributed, record of vertebrate evolution. Even for the history of man, who is a newborn infant in 500 million years of vertebrate evolution, teeth provide the most complete record, with much of human paleontology being based on detailed measurements of the sizes and shapes of teeth. Sometimes, as in the famous Piltdown forgery, the sequence in which teeth erupt becomes important. The wear on the Piltdown canine tooth indicated a relatively early eruption time compared with the molars. This supported the theory that the Piltdown skull had human affinities because, in apes the permanent canine erupts relatively later.

Like man and apes, every species of mammal is characterized by a sequence in which teeth erupt into the mouth. Compared with those of reptiles, these sequences are usually very irregular: for example, in man, if the permanent teeth within a jaw quadrant are numbered 1 to 8 from the front, they erupt in the sequence 6, 1, 2, 4, 5, 3, 7, 8, with minor variations. Because this sequence is repeated in all humans it is evidently genetically controlled, but its particular significance in terms of development, function, and evolution is not known. To unravel this problem it is necessary to trace the evolution of recent mammals from their reptilian ancestors of the Permian, about 300 million years ago.

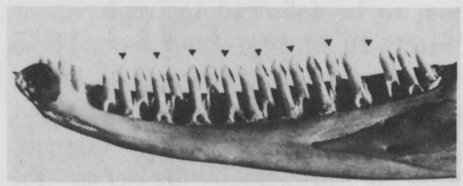

Figure 1

Unlike mammals, which are heterodont (the teeth have different shapes) and diphyodont (they have only 2 dentitions—milk, or deciduous, and permanent), reptiles are usually homodont (all the teeth are alike) and polyphyodont (the teeth are constantly being replaced throughout life). It has been calculated (*1*) that an elderly crocodile may have replaced its front teeth about 50 times. It is intriguing that the teeth of most submammalian

Dr. J. W. Osborn's scholarly paper, "The Evolution of Dentitions", first appeared in *American Scientist* 61, 1973. Both he and the publisher have graciously granted permission for reprinting the paper in the *Virginia Dental Journal.*

vertebrates, including reptiles, are replaced in the following complex but regular sequence. Suppose that one side of a jaw contains 20 teeth and that a new tooth now erupts at the back of the jaw to become the first tooth to occupy the 21st tooth position. Soon after this the odd-numbered teeth are replaced in the sequence 19, 17, 15, 13, and so on. At about this time a tooth appears in the 22nd position, to be followed by replacement of teeth 20, 18, 16, 14, and so on. These replacement waves continue to be initiated and to sweep from the back to the front of the jaw through alternate positions throughout life (Fig. 1). However, in some animals (for example most snakes) the replacement waves sweep through alternate positions in the opposite direction, from the front to the back of the jaw.

Because mammals evolved from reptiles it is evident that, somewhere along the line leading toward recent mammals, the eruption sequence changed. By studying the fossil record between reptiles and mammals it should be possible to plot the way in which mammalian eruption sequences evolved. And if we can understand how the regular reptilian eruption sequences are controlled, it should then be possible to understand how the irregular mammalian eruption sequences are controlled.

Three theories have been put forward to explain the general relationship between the dentitions of reptiles and mammals: the *Odontostichi* (2), *Zahnreihe* (3), and Tooth Family (4) theories. These theories will now be considered.

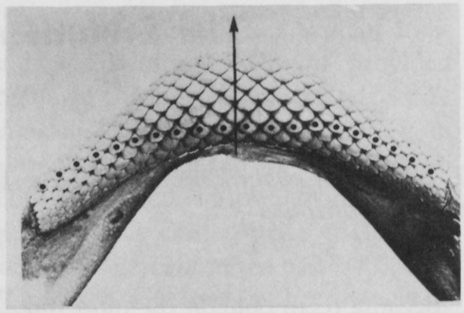

Figure 2

Three dentition theories

The *Odontostichi* theory was originally concerned with tooth replacement in the elasmobranchs. Bolk in 1922 (2) noted that in these cartilaginous fish, the even-numbered teeth are all replaced at about the same time, later to be followed by replacement of the odd-numbered teeth and so on (Fig. 2). He recognized two types of dental units, an *odontostichos*, which is a "horizontal" unit consisting of alternate teeth, and a tooth family, which is a "vertical" unit, consisting of all the teeth which successively occupy a tooth position (Fig. 3A). Bolk concluded that the pattern of tooth replacement in elasmobranchs is due to the existence of two types of *odontostichi*, the even and the odd-numbered *odontostichi*, which he incorrectly concluded had significantly different developmental sites. All the tooth families within an *odontostichos* contribute their replacement teeth to the dentition at the same time, thereby accounting for the strict alternation with which teeth are replaced in elasmobranchs.

Bolk now concluded (without evidence) that reptiles replace teeth in the same pattern as elasmobranchs. And he further concluded (again without evidence) that diphyodont mammalian dentitions have retained the two *odontostichi* present in reptiles (and fish and amphibia): one *odontostichos* has been pushed together to produce the deciduous teeth and the permanent molars, and the other *odontostichos* has been pushed together to produce the replacement teeth (Fig. 3B). This theory now seems most improbable because it does not account for the sequences in which teeth are initiated and erupt in either reptiles or mammals.

We now turn to the *Zahnreihe* theory. Wave replacement of alternate teeth, as opposed to the strict alternation observed by Bolk, was originally described in a mammal-like reptile of the early Triassic (*5*). It was later described in Permian pelycosaurs (*6*) and subsequently extensively documented for fossil and recent submammalian vertebrates by Edmund (*3*).

It must be noted that Edmund's own observations were confined to replacement waves in adult dentitions. However, Woederman (7) had already described the development of the dentition in crocodile embryos. Basing his conclusions on Woederman's data, together with some previous observations on tooth development in fish, Edmund constructed the *Zahnreihe* theory (in 1960) to account for the wave replacement of alternate teeth.

He supposed that there exists at the front of a reptilian jaw a region in

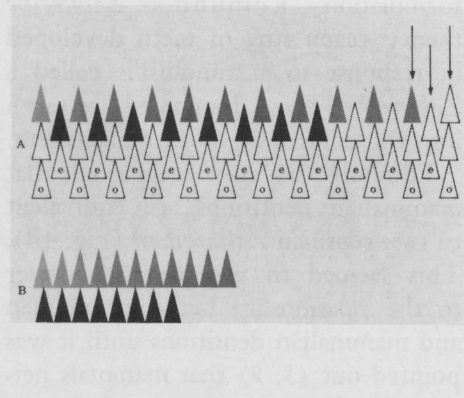

Figure 3

which impulses are generated at regular intervals of time (Fig. 4A). Each impulse leads to the propagation of a stimulus which sweeps from the front to the back of the jaw at a regular speed. When the stimulus reaches a tooth position it causes a new tooth to be initiated. Surprising though it may seem, despite the fact that rows of teeth are initiated in sequence from front to back, such a system can readily lead to the wave replacement of alternate teeth from the back to the front of the jaw (Fig. 4A). Since its

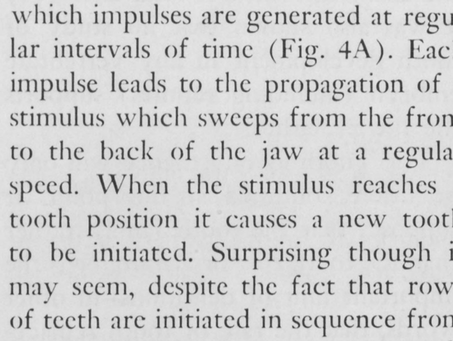

Figure 4

formulation, Edmund's *Zahnreihe* theory (each row of teeth developed in response to a stimulus is called a *Zahnreihe*) has dominated research into the control of tooth replacement.

Edmund (*3*) now suggested that mammalian dentitions are equivalent to two reptilian *Zahnreihen* (Fig. 4B). This seemed to provide the answer to the relationship between reptilian and mammalian dentitions until it was pointed out (*8, 9*) that mammals neither develop nor erupt teeth in the front to back sequence predicted by the *Zahnreihe* theory. And later (*10*) it was also shown that no study of tooth development in any vertebrate embryo (including reptiles) supports the theory either.

The Tooth Family theory will only be briefly outlined at this point. It supposes that the tooth family rather than the tooth row or *Zahnreihe* is the important unit of dentitions—in other words, that the rate of tooth replacement is "vertically" controlled within each tooth family rather than "horizontally" along tooth rows. In order to understand the theory it is necessary to present the data on dental development in reptiles.

Dental development in reptiles

The embryogenesis of reptilian dentitions has been described for *Sphenodon* (*11*), the crocodile (7), and the common lizard, *Lacerta vivipara* (*10*). Of these studies the last is the most comprehensive because every developing dentition (totaling 25 lower jaw quadrants) was reconstructed in full; in neither of the other studies were the dentitions reconstructed. From my own data (*10*) I concluded that it is very difficult, if not impossible, to recognize equivalent tooth germs in different embryos unless the whole dentition is reconstructed.

The jaws of *Lacerta vivipara* hatchlings are about 2 mm long, each quadrant containing about 30 teeth at different stages of development (Fig. 5D). It appeared certain that the precision of the tooth replacement waves in the hatchling was achieved by an equivalent precision during development. But such precision makes it difficult to account for the tiny rudimentary teeth which are frequently produced in the apparently random positions 3, 5, 8, 10, and 13 (Fig. 5D). The solution to this problem became apparent only when the teeth in all the reconstructions had been correctly numbered. The probable sequence of development is shown in Figure 6.

The first tooth bud to be initiated is at the back of the embryonic jaw in what ultimately becomes position 11. This first bud will be called the "dental determinant." From the dental determinant, buds are initiated in sequence toward the front and the back of the jaw. However, those buds anterior to the dental determinant are progressively separated by interstitial growth of the embryonic jaws, with the result that space is created between them for the later development of an intervening row (Fig. 5A, B). Thus, the first row becomes separated and ultimately occupies positions 11, 9, 7, 5, and 3 (buds a in Figs. 5 and 6), while the second intervening row occupies positions 12, 10, 8, 6, 4, and 2 (buds b in Figs. 5 and 6). Interstitial growth of the jaw now ceases, but anteriorly a little further room is created for a final tooth to develop with the 3rd row; this is position 1 (Fig. 5B).

It is now possible to explain why rudimentary teeth are produced in positions 3, 5, 8, 10, and 13. This distribution seems to be related to the time required for the tooth-forming tissues to achieve the competence (in an embryological sense) to contribute to tooth development. During the formation of the earliest buds, none of the tissues is yet capable of laying down mineral; therefore the earliest buds (11a, 9a, 7a, and 12b in Fig. 6) are rudimentary and regress (they are not seen in Fig. 5A). The mesodermal cells of later initiated buds become competent to lay down dentine, but the associated enamel organs cannot yet lay down enamel. The teeth initiated during this time are rudimentary teeth: those which ultimately occupy positions 3, 5, 8, 10, and 13 (3a, 5a, 8b, 10b, 13c in Fig. 6). However, positions 3, 5, and 10 sometimes contain rudimentary buds, and occasionally position 6 contains a rudimentary tooth. In all later developed buds both the dental papilla and the enamel organ are competent to lay down dentine and enamel respectively: all these buds become fully developed teeth.

It remains to explain how the above sequence is controlled. The back-to-front sequence in which the buds of the first tooth row (buds 11, 9, 7, 5, and 3) are initiated is related to the direction in which neural crest cells migrate into the developing jaws. These neural crest cells which have

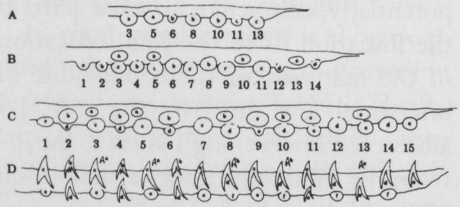

Figure 5

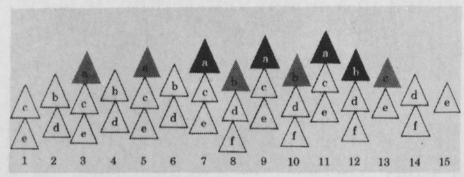

Figure 6

been shown (*12* and *13* among others) to be responsible for initiating tooth buds, migrate forward from the developing neural tube through the jaws.

Finally, it is necessary to explain why tooth buds are evenly separated. It seems probable (*10*) that a tooth bud generates around it a zone of tissue in which the initiation of another tooth bud is temporarily inhibited; were this not the case, one massive fused tooth would be produced which would extend the whole length of the jaw, because all the relevant jaw tissues (even the lip ectoderm, *14*) are potentially competent to take part in the initiation of teeth. The separation of the first row of tooth buds due to interstitial jaw growth (Fig. 5A, B) allows the intervening tissues to escape from the inhibitory zones around each of the buds in the first tooth row. The sequential (as opposed to alternate) initiation of buds behind the dental determinant (11a, 12b, 13c, 14d, 15e in Fig. 6) is due to the presence of tip rather than interstitial growth of potential tooth-forming tissues in this region.

We have now accounted for the sequence in which tooth families are initiated in a homodont reptile. It is evident that the observed sequence (Fig. 6) cannot be explained by either the *Odontostichi* (Fig. 3) or *Zahnreihe* (Fig. 4) theories. However, the Tooth Family theory, with which they have been compared, was originally proposed (*8*) to account for the manner in which the wave replacement of alternate teeth is controlled, not the sequence in which tooth families are initiated.

Tooth replacement

In order to understand the control of tooth replacement it is necessary to understand why teeth are replaced. The most commonly accepted reason for the multiple tooth replacements in reptiles is that they compensate for the wear and accidental loss of teeth. However, although the probably careless and imprecise eating habits of reptiles do often lead to accidental tooth loss, this is unlikely to be the reason for mammalian tooth replacement because the firmly rooted teeth of mammals are very rarely lost accidentally.

What is more likely is that tooth replacement is part of a growth process, at least in mammals. The small teeth that can be accommodated in the small jaws of a child would be quite inadequate in the large jaws of the adult. Unfortunately, with few exceptions such as the rodent incisor and some canines, teeth cannot grow once they have erupted, and so in order to increase tooth size it is necessary to replace a smaller tooth by a larger tooth. I suggest that the same explanation is true for the multiple tooth replacements in submammalian vertebrates. A young crocodile, for example, requires small teeth. Throughout life its lengthening jaws require progressively larger teeth if the two are to be efficiently matched. It must therefore replace its teeth throughout life.

If the above explanation is true of all submammalian vertebrates (and it is supported by the fact that the teeth which they shed with such apparent waste are often remarkably little worn), then why do mammals not replace their teeth more frequently? This question is particularly relevant when it is realized that the dentition is one of the weakest "links" in the "chain" of most mammals' lives: failure of the dentition rapidly leads to death. To answer the above question it is necessary to look at the differences between tooth function in mammals and reptiles.

The upper and lower teeth of most reptiles cannot be brought close together when the jaws are closed because the lower teeth are set inside the upper teeth and the lower jaw cannot be moved sideways sufficiently to bring them into contact. The teeth of reptiles function merely to hold food before it is swallowed. But the teeth of mammals shear across each other to grind food before it is swallowed. The grinding mechanism is efficient because the upper and lower sets of shearing planes developed on each complex tooth mutually wear against each other to produce a precise fit. If teeth were always being replaced, the precisely matched shearing planes would constantly be disrupted (*15*). Therefore, in order to maintain the advantages of an efficient shearing dentition, the permanent teeth of mammals are not replaced. To offset the wear problem the teeth are firmly rooted and are covered with a thick layer of very hard enamel. Tooth replacement in all animals is probably a growth phenomenon, and its control must be looked for in terms of a growth control.

Replacement control

Many growth processes can be expressed by a power equation of the form $T = xe^{yL}$, where T is time, L is length, and x and y are constants. If the addition of new tooth families at the back of the dentition is a growth phenomenon (equivalent to growth in length of the dentition), it seems probable that it could be expressed by an equation of the form $T_{(n)} = pe^{qn}$, where $T_{(n)}$ is the time at which the nth family appears at the back of a jaw quadrant, n is the number of the family, and p and q are constants.

If tooth replacement is a growth phenomenon (equivalent to growth in height of the dentition) and it is controlled within the tooth family, then it might be expressed by the equation $T_{(r)} = ve^{wr}$, where $T_{(r)}$ is the time at which the rth replacement erupts in a particular family and v and w are constants related to the family.

The above two equations can be combined to produce the equation

$$T_{(n)r} = ke^{ar + bn} \qquad (1)$$

where $T_{(n)r}$ is the time at which the rth replacement erupts in the nth family ($T_{(n)o}$ is the time at which the nth family appears in the mouth), and k, a, and b are constants. Theoretically this equation can fully describe tooth replacement in a reptilian dentition (*16*). Provided teeth are replaced at less than 4 times the rate at which new families are added to the back of the dentition, there is a greater than 4:1 chance that teeth will be replaced in waves that sweep through alternate tooth positions even if no other form of control were present (*16*).

From equation (1) the time taken to add the nth tooth family to the dentition is given by

$$T_{(n)o} - T_{(n-1)o} = ke^{bn} - ke^{b(n-1)} = ke^{b(n-1)}(e^b - 1) = T_{(n-1)o}(e^b - 1)$$

In other words the time taken to add the nth family is a constant $(e^b - 1)$ times the age of the animal at which the adjacent anterior family was added to the dentition $(T_{(n-1)o})$. This result can be explained in terms of the inhibitory zone which it was earlier suggested temporarily surrounds a newly initiated tooth; it takes progressively longer to add new tooth families because, in conformity with the progressive decrease in the rate at which the jaws grow in length, it takes progressively longer for the potential tooth-forming tissues to escape from the inhibition of the anteriorly adjacent tooth family.

Also from equation (1), if N is a particular family, the time taken to replace the rth tooth is given by

$$T_{(N)r+1} - T_{(N)r} = ke^{a(r+1)+bN} - ke^{ar+bN} = ke^{ar+bN}(e^{a} - 1) = T_{(N)r}(e^{a} - 1)$$

In other words, the time taken to replace a tooth is a constant $(e^{a} - 1)$ times the age of the animal when its predecessor erupted. And in terms of inhibition, each tooth inhibits the initiation of its replacement for a constant times the age of the animal when the tooth itself was initiated. It will also be noted from the above result that every family initiates replacement teeth at a rate which differs from all other families because the value of $T_{(N)r}$ in the expression $T_{(N)r}\ (e^{a} - 1)$ is different for every family.

The Tooth Family theory is best summarized by the original equation $T_{(n)r} = ke^{ar + bn}$. Tooth replacement involves two controls: an overall control represented by e^{ar} which is the same for every family (it is independent of n), and a family specific control, e^{bn}, which differs for every family (because n is different for every family).

Finally, if the addition of new tooth families represents growth in length of the dentition and tooth replacement represents growth in height of the dentition, then the pattern of unerupted, erupting, and functioning teeth represents the two-dimensional shape of the dentition—a shape which is expressed as the wave replacement of alternate teeth. The maintenance of this shape by two control constants (a and b) is as easy (or as difficult) to understand as the maintenance of the shape of a bone during the growth of an animal.

Tooth initiation in recent mammals

Now that we have explained the polyphyodonty of submammalian vertebrates as the expression of a growth phenomenon controlled by a tooth family specific and an overall control, it is necessary to look at the evidence of tooth initiation in recent mammals. The ancestral eutherian mammal is generally considered to have possessed 3 incisors, a canine, 4 premolars, and 3 permanent molars in each jaw quadrant. With very few exceptions (for example, the aquatic mammals), recent eutherian mammals either possess this dental formula (expressed as I3, C1, Pm4, M3) or have lost one or more teeth. What was the sequence in which teeth were initiated in the ancestral eutherian mammal? To answer this question it is necessary to look at the data for recent mammals, in particular those which still possess the full eutherian complement.

The most accurate method of assessing the sequence in which teeth are initiated is to reconstruct the developing dentitions of serially sectioned, closely timed embryos. However, the earliest mammalian embryos in which tooth buds are found nearly always seem to contain a newly initiated incisor, canine, and deciduous molar. This is true even of a very closely timed series of human embryos *(17)*.

In the absence of early embryos it is probably safe to assume that where two teeth are at different stages of development, the more developed was the earlier initiated, particularly if the relevant teeth are each at a stage before the onset of mineralization. Using this criterion, data for the mole *(18, 19)* seem to indicate that the 3 deciduous incisors and 3 permanent molars are each initiated in sequence from the front to the back of the jaw, whereas the 4 deciduous molars are initiated from the back to the front of the jaw (Fig. 7A). It will be noted that the mole dentition is one of the few which has maintained the full eutherian dental complement.

However, most studies (including the above study of the mole) have not been specifically concerned with the sequences of tooth initiation. For example, despite his own data for the mole *(19)* Ziegler constructed a theory to explain the evolution of mammalian dentitions which assumes that the teeth of all reptiles and mammals are initiated in sequence from the front to the back of the jaw *(20)*. In fact nearly all the data for insectivores *(21)* show the same sequences as those of the mole (Fig. 7B). I am preparing a paper in which these data will be discussed, but for the moment it will be assumed that in the ancestral eutherian mammal, just as in the mole and most other recent eutherian mammals, the deciduous incisors were developed in front-to-back sequence, the deciduous molars developed from back to front, and the permanent molars developed from front to back.

It has already been stated that the earliest embryos in which tooth formation is evident usually contain a deciduous incisor, canine, and molar. These teeth will be called the incisor, canine, and molar determinants, respectively. It will be noted that in the ancestral eutherian mammal, Dm4 (the 4th deciduous molar) was probably the molar determinant. In the reduced postcanine dentitions of most eutherian mammals the only difference is that the penultimate rather than the most posterior deciduous molar may sometimes be the molar determinant.

Reconstructions of developing insectivore dentitions *(21)* seem to show that room for the deciduous incisors and molars is created in the embryonic

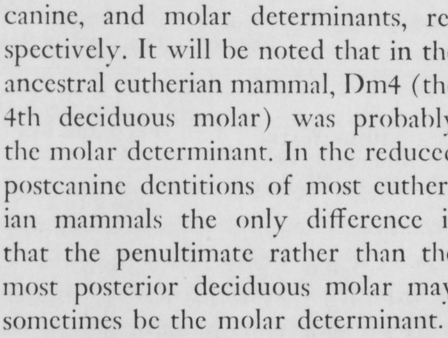

Figure 7

(Continued on page 50)

SUPPLEMENTAL SYSTEMIC AND POST ERUPTIVE FLUORIDE THERAPIES

by

** George P. Barnes, DDS, MSD*

TABLE 1

EMPIRICAL DOSAGE FOR SYSTEMIC FLUORIDE SUPPLEMENTS

Home Water Fluoride Level in PPM	Adjusted Dosage of Fluoride Ion (mg. per day)		Adjusted Dosage of Sodium Fluoride (mg. per day)	
	Age 2 to 3	Above Age 3	Age 2 to 3	Above Age 3
0.0	0.5	1.0	1.1	2.2
0.2	0.4	0.8	0.9	1.8
0.4	0.3	0.6	0.7	1.3
0.6	0.2	0.4	0.5	0.9

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To date, the public health measure which most effectively reduces the incidence of dental caries is the addition of the fluoride ion to drinking water supplies. Although water fluoridation may have some posteruptive effect, its major cariostatic action results from ingestion of the fluoride during tooth development and calcification. Since the adoption of communal fluoridation in the 1940's, a myriad of studies has been conducted to evaluate the effects of various supplemental systemic and posteruptive fluoride therapies. These efforts have included testing of measures designed to supplement the effects of communal fluoridation, as well as measures designed for use in areas where water fluoridation is either unavailable or not feasible. Essentially these additional fluoride therapies include the prescribing of systemic fluoride supplements; the topical application of fluorides as either solutions, gels, prophylactic pastes, or mouth rinses; and the use of fluoridated dentifrices.

This effort is intended to be a partial review of the literature concerning the various fluoride treatments other than communal fluoridation. This review is directed to the clinician to provide him information about the advantages, disadvantages, indications, contraindications, mechanisms of action, efficacy, and techniques of administration of each of the agents mentioned.

SYSTEMIC FLUORIDE SUPPLEMENTS

The daily administration of systemic fluoride supplements, as sodium fluoride, has been demonstrated to reduce the incidence of dental caries among children living in areas where the drinking water supplies are deficient in fluoride[1-8]. The main mechanism of action of the systemic fluoride supplements is probably the same as the mechanism of communal fluoridation. A partial substitution of fluoride into enamel apatite during tooth formation and calcification results in an apatite which is less soluble in decalcifying acids.

Systemic fluoride supplements may be administered in at least three forms —tablets, lozenges, and as a solution. The clinician should consult *Accepted Dental Therapeutics* for a list of the accepted systemic fluoride supplement preparations[9].

The cariostatic effectiveness of systemic fluoride supplements appears to be less than that of communal fluoridation. A consensus of the literature cited appears to indicate that the daily use of these supplements over a long period of time may result in 30% to 35% reduction in the incidence of dental caries in children. No evidence is available which would indicate anticariogenic effectiveness in adults. In fact, after the age of 14, the patient probably derives little benefit from this therapy. Although one very limited study[10] suggested a small benefit in the children of mothers who received these supplements during pregnancy, the usefulness of prescribing fluorides to pregnant females has not been clearly demonstrated, and the Food and Drug Administration has stated that prenatal fluoride tablets should not be prescribed until additional information is available[11].

The dosage of systemic fluoride supplements to be prescribed is dependent upon the amount of fluoride present in the home water supply and the age of the patient. In order to avoid the possibility of dental fluorosis, the dosage should be adjusted downward in proportion to increases in the concentration of the fluoride present in the drinking water supply. Table 1. depicts an empirical adjustment that should provide a conservative allowance of fluoride for children of various ages. As illustrated in this table, no specific daily allowances are suggested for children under age two. For these children it is suggested that their drinking water and formula be prepared by mixing 1.0 milligram of fluoride in 1.0 liter of water, thus providing 1.0 ppm[9]. Supplemental fluorides should not be prescribed when the home water fluoride concentration is 0.7 ppm or greater. Obviously the exact amount of fluoride present in the home water supply must be determined prior to prescribing these supplements. In most cases, these analyses may be obtained at nominal cost. If a source for water analysis is unknown, the practitioner might consult his state dental public health officials.

As a safety factor, large quantities of fluoride should not be stored at home. Therefore, it is recommended that no more than 264 milligrams of sodium fluoride should be dispensed at a given time. Additionally, the container should be marked: "Caution—store out of the reach of children".

Katz, McDonald and Stookey[11] called attention to another major factor which must be considered in prescribing fluoride supplements—the conscientiousness of the patient and parent. This therapy requires that the patients consistently ingest one dosage each day. Failure to do so mitigates against significant anticariogenic effectiveness. Theoretically, it could be more convenient for parents if their children ingested preparations containing sodium fluoride and vitamins in combination. Studies[2,8] have demonstrated a cariostatic effect following the ingestion of vitamin-fluoride preparations; and a number of these products are commercially available. However, there is no evidence that the vitamins enhance the effectiveness of the fluoride. Also the fixed proportion of ingredients in the combination makes adjustment of the dosage more difficult in areas where the drinking water contains substantial, but inadequate levels of fluoride. Consequently, the Council on Dental Therapeutics has not accepted preparations containing vitamins and fluoride in combination[9].

TOPICAL FLUORIDE APPLICATIONS

Within the last three decades, numerous fluoride compounds have been evaluated for their anticariogenic efficacy when applied topically to the dentition. Historically, three topical fluoride compounds have received the most attention and application in dentistry—sodium fluoride, stannous fluoride, and the acidulated fluoride-phosphate systems (APF). Additionally, Shannon[12, 13] has recently suggested topical application of the latter two agents to be used sequentially in combination.

In one respect, the mechanisms of action of sodium fluoride, stannous fluoride and the acidulated fluoride-phosphate systems are identical. As a result of topically applying either of these agents to enamel, a layer of calcium fluoride is formed on the surface of the tooth. The fact that calcium fluoride is less soluble than apatite in decalcifying acids, to a large extent, explains their cariostatic effect. In the case of sodium fluoride, this is probably the sole mechanism of action.

In addition to the fluoride's action, it has been suggested that the stannous ions in stannous fluoride have a cariostatic effect. These ions react with enamel, particularly the phosphate ions of incipient carious lesions, to form insoluble, tenacious, and adherent tin phosphates or tin fluorophosphates[11]. The tin phosphates or fluorophosphates may prevent further progression of the decalcification process and thus result in arrestment of the incipient carious lesion. Tin fluorophosphates also may be a reaction product of stannous fluoride with noncarious enamel, especially when the stannous fluoride is applied in a prophylactic paste.

In the case of the acidulated-fluoride phosphate systems, it has been suggested, that application of APF to enamel results in the formation of a fluoride substituted apatite. Probably topical application of this agent results in the formation of both calcium fluoride and "fluorapatite".

The application of all of the topical fluorides–sodium, stannous and the acidulated fluoride-phosphates–must be preceded by a prophylaxis with either zirconium silicate, lava of pumice or a similar prophylactic paste. The technique of topically applying sodium fluoride was developed by Knutson[14]. This technique requires the application of a 2.0% sodium fluoride solution to the teeth for a period of 4 minutes. A total of four such applications are required over a three week period. The acidulated-fluoride phosphates are available as either solutions, gels or prophylactic pastes. All of these forms contain approximately 1.23% fluoride as sodium fluoride and hydrofluoric acid. Additionally, they usually contain 0.98% phosphoric acid. The APF solutions and gels may be applied with a swab. A preformed tray also may be used for applying the gels. A treatment time of 4 minutes is recommended and this therapy should be repeated at six-month intervals. The patient is advised to refrain from consuming food or drink for 30 minutes following treatment. When they are incorporated in a prophylactic paste, the standard prophylaxis technique is utilized in applying both APF and stannous fluoride. Although a series of in vitro studies[11] indicated that many of the APF prophylactic pastes had little effect in reducing the solubility of enamel in organic acids, a recent report[15] revealed at least one of these pastes to be significantly effective as a cariostatic agent in children. Stannous fluoride may be applied as either an aqueous solution or a prophylactic paste. While 10% stannous fluoride solutions have been applied to the teeth for 30 seconds, the current suggested procedure appears to be use of an 8% solution for 4 minutes. This single treatment procedure should be repeated at six-month intervals. Stannous fluoride prophylactic pastes may be prepared in the operatory by mixing the agent with lava of pumice or zirconium silicate. At least one stannous fluoride prophylactic paste is available commercially*. It contains approximately 9.0% stannous fluoride and 9.0% sodium dihydrogen phosphate. In addition to operator application of this paste, studies[16-19] have been conducted evaluating supervised patient self-application of the agent. This method of applying the paste has been reported to be an effective caries preventing measure[16-18]. In suggesting APF and stannous fluoride to be used sequentially in combination, Shannon[12, 13, 20, 21, 22] recommends preparations with decreased stannous fluoride concentrations, to be used frequently. Additional to the 1.23% APF, he recommends a gel and a solution each containing 0.5% stannous fluoride, a prophylaxis paste containing 2.0% stannous fluoride, and a 0.1% stannous fluoride mouthwash. The mouthwash is in a glycerin base, rather than an aqueous solution. This investigator further recommends that when using APF and stannous fluoride sequentially, the APF treatment should always precede the stannous fluoride application.

In comparing the efficacies of the various topical fluoride agents, the in vitro studies demonstrating sodium fluoride, stannous fluoride, the acidulated-fluoride phosphate systems, and the combined use of APF and stannous fluoride, each to be significantly effective in decreasing the solubility of enamel in organic acids, are too numerous for discussion. Likewise, countless laboratory studies have shown topical applications of each of these agents to result in increased fluoride uptake by the enamel surface. While in vitro studies are useful in evaluating the cariostatic effects of fluorides, the exact relationship between their criteria and the actual development of caries has not been fully established. DePaola[23] concluded that the present in vitro tests are not good indicators of clinical efficacy, and that findings from clinical fluoride trials have not been consistent with those from in vitro tests. Shannon,[24] as well as others,[11] has concurred with this opinion. Therefore, further discussion of the efficacies of the various fluoride compounds will be limited to the results obtained from human clinical trials conducted under various environmental conditions.

When topically applied to the dentition of children residing in areas where the water supplies are deficient in fluoride; sodium fluoride, stannous fluoride, and the acidulated-fluoride phosphates, all have demonstrated significant effectiveness in reducing the incidence of dental caries[15, 25-36]. However, a review of the literature indicates that consistently lesser degrees of caries protection have been observed following the use of sodium fluoride than following stannous fluoride or acidulated phosphate-fluoride. Topical stannous fluoride and APF

Zircate Treatment Paste—L.D. Caulk, Milford, Delaware.

therapies appear to be equally effective when rendered to children living in nonfluoridated areas.

When topically applied to the dentition of children living in areas where the water supplies contain optimum fluoride levels, sodium fluoride appears to provide little additional cariostatic effect. The findings of Downs and Pelton[37], Galagan and Vermillion[38], and McDonald and Muhler[39], seem to substantiate this conclusion. Several reports[39–44] have indicated that topical applications of stannous fluoride provide additional anticariogenic benefit when rendered to children living in fluoridated communities. In some instances, these treatments were rendered as stannous fluoride solutions; in other cases stannous fluoride prophylaxes were tested; and in still other trials, both vehicles were evaluated. When rendered under these conditions, stannous fluoride appears to provide an additional cariostatic benefit of 40% to 45%. Only one clinical study[45] involving topical application of acidulated phosphate-fluoride to the teeth of children living in a fluoridated area has been reported. During the "school years," this agent in gel form was applied to the children's teeth three times a week for 30 months. The results appeared to indicate reductions in the incidence of dental caries of 25% to 30%. Thus it appears that the practitioner's choice of topical fluoride agents may be somewhat decreased when treating patients living in a fluoridated community.

When rendering topical fluoride therapy to adults, the clinician's choice of agents may be further limited. The results of human clinical trials with sodium fluoride have failed to show any cariostatic benefit when the agent was applied to the dentition of adults[46–50]. Conversely, several articles[51–57] have reported stannous fluoride to have a caries preventing effect when applied as topical solutions, prophylactic pastes, and dentifrices, either singly or in combination, to the adult dentition. To date, no clinical studies evaluating the effect of the acidulated fluoride phosphate systems on the incidence of dental caries in adults have been reported. Although lack of studies does not preclude the possibility of cariostatic benefit in adults, data in this regard are clearly needed before the use of APF in treating this age group can be recommended.

Although several in vitro studies[12, 13, 20, 21] have demonstrated significant reductions in enamel solubility and increased enamel fluoride uptake following the topical administration of APF and low concentrations of stannous fluoride sequentially in combination, there appears to be a lack of articles reporting the effect of this treatment in human clinical trials. There is a need for carefully controlled clinical studies evaluating the effect of this therapy on the incidence of dental caries in adults and children living in both fluoridated and nonfluoridated communities.

It must be pointed out that under different environmental and patient age conditions, the various topical fluorides appear to have other advantages and disadvantages when compared. Stannous fluoride is not stable in water.

Hence, 8% and 10% aqueous solutions of this agent intended for topical application must be freshly prepared for each patient. When the commercially available stannous fluoride prophylactic paste is used, stability is not a problem. Likewise, the APF gels and solutions are stable preparations. Since the stannous fluoride gel, solution and mouthwash suggested by Shannon[12, 13, 20, 21, 22] are prepared in glycerin rather than water, stability is not a problem. Although the more concentrated stannous fluoride solutions have an unpleasant taste, this does not appear to be a problem with the acidulated fluoride phosphate systems. On a few occasions, minor and reversible soft tissue reactions have been reported following the application of stannous fluoride solutions. However, these reactions have occurred only when there has been an existing gingivitis in the area where the agent was applied. No soft tissue reactions have been noted following the use of APF. A light tan staining of the enamel in areas of incipient carious lesions following application of stannous fluoride solutions has been reported[58]. It is believed, however, that this is an effect of the tin ion and denotes caries arrestment of those lesions. At least three reports[59–61] have indicated the role of stannous fluoride in arresting incipient carious lesions. Even though the acidulated phosphate-fluorides do not cause pigmentation of enamel, there have been no suggestions that they arrest existing carious lesions. It has been suggested that the sequential combined use of APF and low concentration stannous fluoride might incorporate the advantages, and minimize the disadvantages, of both agents.

It is important to note that in addition to the therapies which have been discussed, other fluoride compounds continue to be studied to determine their feasibility for use as topical agents. For example, in vitro studies evaluating the effects of titanium tetrafluoride have been reported[62, 63]. Other reports[64–66] of in vitro and clinical studies have indicated that certain amine fluoride compounds are effective in reducing the incidence of dental caries. The amine fluorides are of interest because, additional to the fluoride action, they may have plaque inhibitory effects. However, currently none of these fluorides is commercially available in this country. For a listing of the accepted topical fluoride preparations, the practitioner is referred to *Accepted Dental Therapeutics*[9].

DENTIFRICES CONTAINING FLUORIDES

On the basis of laboratory and clinical studies, two dentifrices containing fluoride have been accepted by the American Dental Association's Council on Dental Therapeutics as being effective in helping to prevent dental caries. One of these contains 0.4% stannous fluoride* and the other contains 0.76% sodium monofluorophosphate**. The mechanisms of action of the stannous fluoride dentifrice are

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* *Crest toothpaste—The Proctor and Gamble Company, Cincinnati, Ohio*

***Colgate with MFP fluoride—Colgate-Palmolive Company, New York, NY*

(*Continued on page 63*)

THE PATIENT'S RESPONSIBILITY TO THE DENTIST

From the day he registered as a freshman in dental school, every dentist has been made aware of his many responsibilities to his patient. Now is the time for all agencies of dentistry to acclaim publicly that the dentist-patient relationship is a mutual one, with the patient having his obligations as well as the dentist.

With third parties involving themselves in dental care, a new kind of patient now occupies the dentist's chair. As a newcomer to dentistry, he does not know how to behave as a patient nor has anyone ever made an effort to inform him that as a patient he, too, has certain obligations that affect the dentist-patient relationship.

Patients must be made aware of what dentists expect of them relating to the dental appointment, who the appointment is for, general patient behavior, and financial responsibility.

The patient has the responsibility of keeping his dental appointment. If he fails, without adequate prior cancellation notice, his privilege to receive further dental care should be denied. The dentist rightfully should expect to be compensated for the time he lost due to the absent patient.

Dental auxiliaries should not be expected to double as baby-sitters. The duty of the dental assistant is to assist the dentist at his chair.

The patient should know that the dentist takes pride in his profession and in the physical set-up of his office. "No smoking" signs should be honored. Patients should not dispose of cigarette butts and candy wrappers in a potted plant. Office furniture should be respected. Loud talk and horesplay by those in the waiting room distract the dentist and disturb other patients.

The individual financially responsible for the patient's account must be aware of that responsibility before the first appointment.

Representatives of organized dentistry should be included on panels of social service workshops and conventions, so that the voice of dentistry may be heard by the social worker.

The philosophies of the practicing dentist pertaining to patient relations should be publicized during the next National Dental Health Month.

All insurance companies, dental service corporations, and similar agencies providing fee schedules should see that such schedules contain this message: "This carrier will not be financially responsible for your broken dental appointment."

Medicaid and Veterans Administration administrators should educate their own eligible clients relative to the broken-appointment problem.

The American Dental Association should take the lead in extracting the dentist and his auxiliaries from their part-time roles as social workers, lawyers, and bill collectors, and return them to the dental chair where they belong. [McCracken, Stewart C. 42 Ridgewood Terrace, Springfield, Mass. The patient's responsibility to the dentist. J Mass Dent Soc 22:99-101 Spring 1973]

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Enlarged Styloid Processes As A Complication In Mandibular Prognathism Surgery: Report of a Case

by

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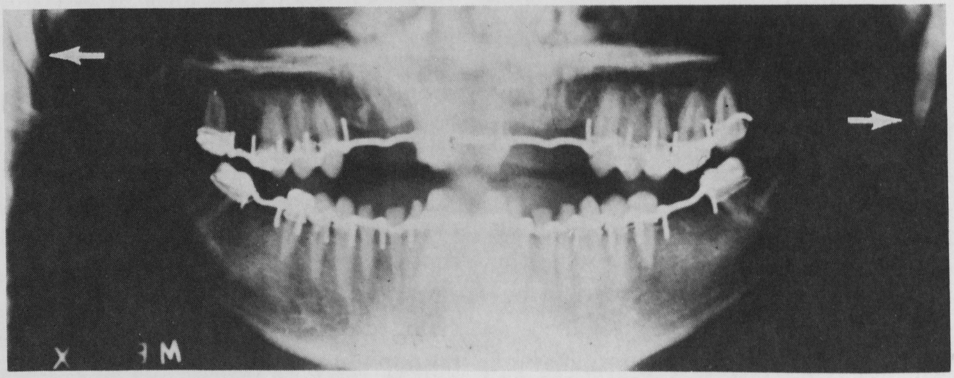

Fig. 1 Panorex radiograph revealing bilaterally enlarged styloid processes. Note arrows.

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An 18 year old male, seen on routine dental examination, was referred to the Oral Surgery Clinic for evaluation of possible surgical correction of mandibular prognathism. After proper work-up and model surgery, it was determined that a bilateral vertical sliding osteotomy in the ramus of the mandible would enhance the patient's occulsion and esthetics. The patient was receptive to the proposed procedure and was scheduled for surgery after psychiatric consultation confirmed his understanding of the procedure.

Radiographs revealed an enlarged mandibular canal, and bilaterally hypertrophied styloid processes, extremely elongated, but not quite representing the classical "Eagles Syndrome" described in the literature.

On 20 April, 1970, in the operating room under general anesthesia, the patient underwent surgery for correction of the mandibular deformity. A vertical sliding osteotomy was performed bilaterally.

Following this part of the procedure it was found that the mandible could not be repositioned posteriorly due to the close proximity of the styloid processes. The extraoral wounds were reentered and the styloid processes were isolated by blunt dissection and fractured, using mallet and chisel. Exposure and identification of the styloid processes was facilitated by utilizing a nasal speculum as a retractor. This allowed a satisfactory posterior repositioning of the mandible, and satisfactory occulsion was obtained. This occlusion was maintained initially by intermaxillary elastic traction. The incisions were closed, and the usual pressure dressings were applied.

The fixation appliances were removed in six weeks, and recovery was uneventful. The patient had good mandibular function with no limitation in range of motion.

SUMMARY

An operative complication of enlarged styloid processes was encountered during a surgical procedure for correction of mandibular prognathism, and a solution to this problem was described. We were concerned about mandibular function postoperatively due to the proximity of the ramus to the styloid processes. This was not a problem.

The proximity of vital structures (internal carotid artery and jugular vein) to the styloid process must be kept in mind. To minimize the possibility of violation of these structures mentioned, the process was fractured near the base of the skull.

Preoperative considerations are an important part to any surgical procedure. The styloid processes should be scrutinized and considered as a possible complication in prognathism surgery.

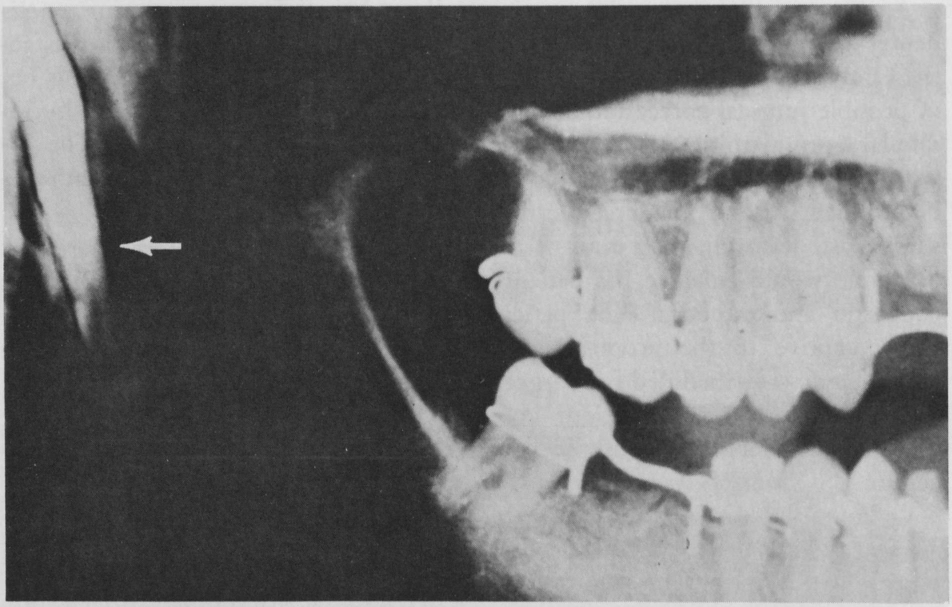

Fig. 2 Right Styloid Process.

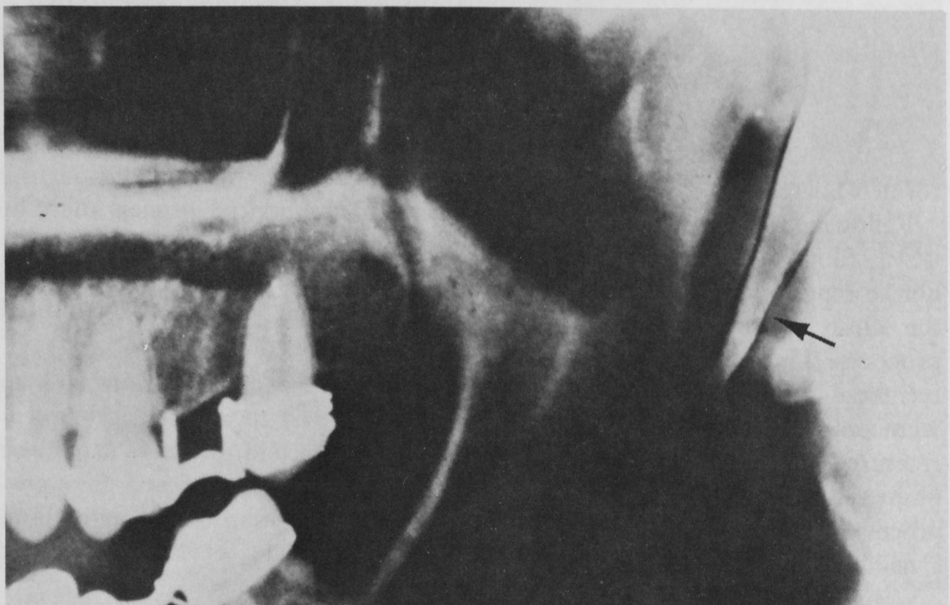

Fig. 3 Left Styloid Process.

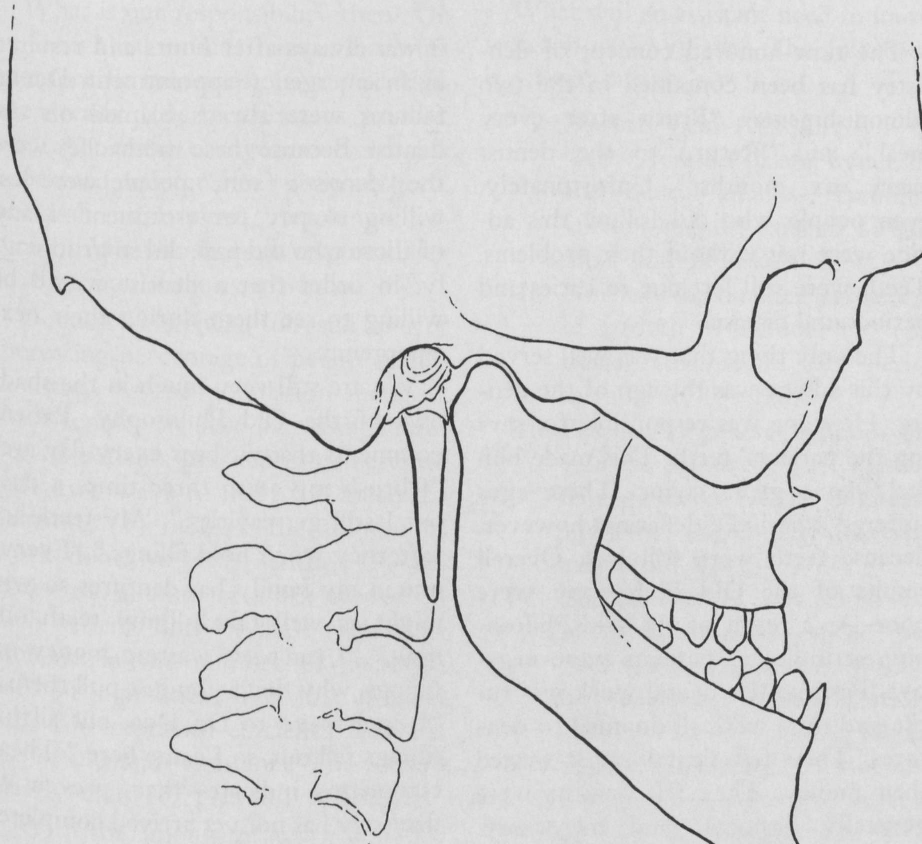

Fig. 4 Line drawing demonstrating position of the styloid process to Posterior border of the mandible, as determined by cephalometric radiograph.

The Role of the Dental Assistant in Teaching Oral Hygiene

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Richmond, Virginia

The time-honored concept of dentistry has been contained in the two admonishments: "Brush after every meal," and "Return to the dentist every six months." Unfortunately, even people who did follow this advice were not without their problems. Teeth were still lost due to caries and periodontal disease.

The only thing that was well served by this advice was the ego of the dentist. He alone was responsible for saving the patients' teeth. This made him feel like a great savior. These egos suffered a periodic deflating, however, because teeth were still lost. Overall results of the Old Philosophy were poor. As a result of the Old Philosophy, attitudes of patients were negative. Patients felt dental work was futile and they were all doomed to dentures. They felt dental work wasted their money. They felt dentists were generally dishonest and mercenary. This philosophy left something to be desired from the dentist's viewpoint also.

Following the dentist's advice was no guarantee the patient still wouldn't develop pain. When he did, it seemed it was always after hours and resulted in an emergency appointment. Dental failures were always blamed on the dentist. Because these toothaches were the "dentist's fault," people were less willing to pay for treatment. Many of those who did pay, did so grudgingly, in order that a dentist would be willing to see them during their next emergency.

We are still very much in the shadows of the Old Philosophy. Patient comments that we hear every day are: "I brush my teeth three times a day, but I still get cavities," "My teeth are soft, they won't hold fillings," "Everyone in my family has dentures so you might as well take all my teeth out now," "I can't see wasting money on fillings, why don't you just pull them," "I used to go to Dr. Doe, but all his fillings fell out, so I came here." These comments indicate that preventive dentistry has not yet arrived completely.

The new concepts of preventive dentistry change things around completely. Dental problems are now recognized as a disease which must be controlled before treatment can begin. As members of the dental profession we have two basic aims: (1) to restore the patient to a condition of oral health, (2) to maintain that oral health

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This is a review of a lecture presented at the State Meeting of the Virginia Dental Assistants Association in Arlington, Va. on September 30, 1973.

once established. Unfortunately, neither of these can be accomplished by the dental profession alone. If the patient cannot or will not control his disease then all treatment is doomed to failure. The patient must assume responsibility for the control of his disease.

What is our responsibility then? On an individual patient basis it becomes two specific functions: (1) repair damage already done (restorations, partials, etc), (2) make changes necessary for continued maintenance (perio-surgery, occlusal adjustment, teaching hygiene). We also have a responsibility to the population as a whole.

Dentistry is striving to reach an ever increasing percentage of people in this country. As the population increases this becomes an ever increasing number of patients per dentist. There are only two ways to meet the increased demand: (1) increase the amount of work done by each dentist, (2) decrease the amount of work needed by each patient. Both of these require an increase in the number of assistants used in a practice. The first method calls for improved efficiency and the use of chairside assistants. The second clearly calls for preventive dentistry.

With the amount of work done by each dentist increasing, the time remaining does not afford the luxury of a one to one ratio of dentist to patient for teaching oral hygiene. Part of this teaching will have to be relegated to an assistant. This person will be the preventive assistant. As time goes on this will be recognized as a specific part of a dental practice, just as we now recognize a chairside assistant.

Those assistants who become proficient in teaching preventive dentistry will become a valuable part of the dental practice. Next to the dentist they will be the most valuable persons on the dental staff. We may further expect that this value will have to be reflected in their salaries.

What will an assistant need to know to teach oral hygiene? The following is a basic outline.

I. Normal Oral Anatomy
   Teeth, tongue, palate, uvula, lip and buccal mucosa, frenums, salivary glands, exits of Wharton's and Stensen's ducts.

II. Normal attachment mechanisms of a tooth to include: (1) epithelial attachment, (2) periomembrane, (3) bone.

III. Plaque (1) general types of organisms involved, (2) specific damage done by perio disease and how, (3) damage done by caries and how.

IV. Plaque control (1) Floss—explanation, demonstration, patient training, (2) Toothbrush—explanation, demonstration, patient training, (3) Mouthwash containing various agents—explanation only, (4) Effects of fluoride on plaque and teeth—explanation only.

V. Conditions affecting oral tissues
   Teeth—Caries and stains
   Gingiva—Gingivitis, periodontitis, leukemia, Dilantin
   Tongue—Vitamin deficiency, antibiotic therapy
   Bone—Abscesses, diabetics
   Mucosa—Leukoplakia, leukoedema

VI. Gross characteristics of cancer and treatment (1) raised rolled red border (2) induration (3) immobility (4) duration—over 3 weeks, (5) time is essential—treatment must be rendered as soon as possible, never to exceed 90 days.

VII. Principles of teaching and motivation (1) Communication—understand principles of Johari Window, (2) Instruction techniques—small step size, patient participation, immediate feedback, accurate pacing, (3) Motivation—understand principles of Maslow's Heirarchy, (4) Sustained motivation – recall based on patients' dental and psychological needs.

To some this may appear to be an excessive amount of information, but several things should be kept in mind. First, the patients will be asking many related questions that a preventive assistant should be prepared to answer. Second, because the assistant may be seeing a patient before the dentist does on a recall visit, she should be able to recognize gross pathology. No one will expect an assistant to attempt a definitive diagnosis of any pathology, but she should recognize any gross swelling or lesion and call them to the attention of the dentist for evaluation.

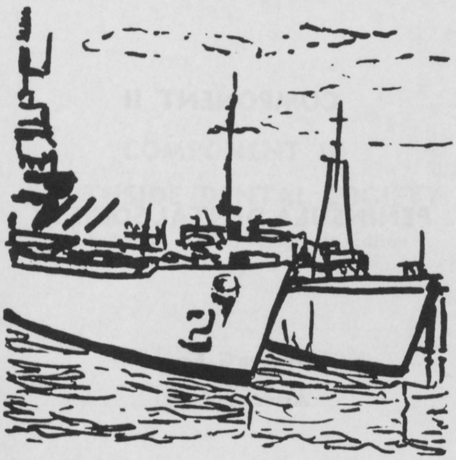
This only represents a basic outline. A great volume of information may be accumulated in any of the categories listed, and certainly it is never impossible to know too much. To be an effective preventive assistant a general knowledge of all the aforementioned subjects is essential.

THE VDA LIVING ENDOWMENT FUND

Recently the VDA contributed a check for $2,000 to the Dean of the MCV School of Dentistry. This contribution, arranged by the Student Loan and Scholarship Committee, will be earmarked for worthy students of Dentistry at MCV. This money will be matched ten-to-one by the American Fund for Dental Education, so it represents $20,000 made available by your Association!

This LIVING ENDOWMENT FUND is an easy way in which you can contribute to the education of Dental Students in Virginia during your own lifetime. Also, upon the death of a member anyone can contribute to this fund so matching money can be obtained through the Central Office in memory of the deceased.

COMPONENT NEWS



COMPONENT I

VIRGINIA TIDEWATER DENTAL_ASSOCIATION

Cecil J. Carroll

Associate Editor

At our February meeting, the following men were elected to component membership: Andrew J. DeLisle, Quincy B. Gilliam, Jr., Bernard E. Glover, Allan C. Sundin, Albert L. Vogel, Jr.

Continuing Education marches on in Tidewater. The Willy Cappem Restorative Society announced that its devotees of inlay fixed bridges have developed their techniques to the point where their prostheses last almost six months before marginal leakage is detectable and up to eighteen months before symptoms of pulp exposures are noticeable.

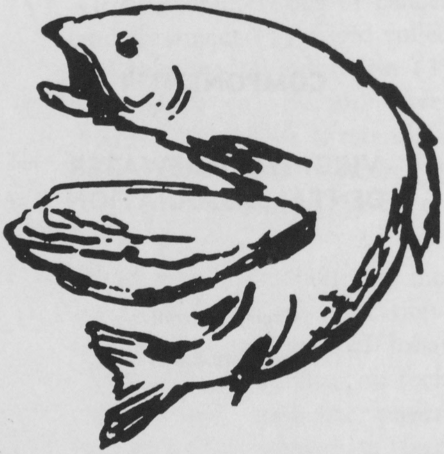
On a higher plane is the following report from Manny Michaels, President of the VTDA Foundation:

"The Virginia Tidewater Dental Association Foundation has presented to the members of Component #1 three evenings of video-cassette-TV continuing education programs. Each program was attended by a good audience, about 50-70 people, and elicited a good deal of interest and comment.

"A video program is planned for the first Thursday night of every month. We are indebted to the School of Dental Hygiene at Old Dominion University for their cooperation and for the use of their equipment and facilities.

"We see the need in our continuing education curriculum for a steady but varied series of presentations from which the practitioner can choose what interests him and suits his needs. The video cassette provides this with ease and at a minimal cost. We do not see this as a replacement for the traditional lecture because it is impersonal, and there is no way to obtain that intangible quality which is imparted by a live presentation. The media does not allow a chance to question the speaker or a way in which to absorb the enthusiasm that is generated in a face to face confrontation. However, the video cassette places the viewer in a position to see a procedure from chairside and yet magnified to provide a bigger than life picture. The range of titles on tape is fast growing, and probably will be unlimited from a practical standpoint."

COMPONENT II



PENINSULA DENTAL SOCIETY

Mayer G. Levy

Associate Editor

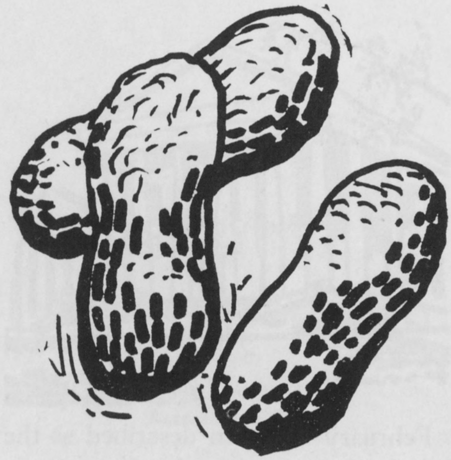
If you haven't tried it, do. It's just like in the books and movies. Members of the Executive Committee of the Peninsula Dental Society met in an honest-to-goodness smoke filled hotel room with our local legislators. The other health oriented guests were difficult to discern across the room, but their voices indicated an interest in the local health departments. We found our representatives very attuned to health needs (other than lung cancer) and State budgeting. We dentists felt good about letting our positions be known.

Our neighbors at the Fort Eustis Dental Clinic hosted another outstanding dinner meeting featuring Col. Bass on chemotherapy. He early pointed out the dangers of allowing infection to travel through facial pathways and of using drugs with known side effects. A prime example is Ilosone, which may have untoward sequela with impaired hepatic function and in pregnancy.

Component Two has begun arranging for the 1975 V.D.A. meeting at the Hampton Roads Coliseum. 'Member now, y'all come.

COMPONENT III
SOUTHSIDE DENTAL SOCIETY

Edward G. Howe, Associate Editor



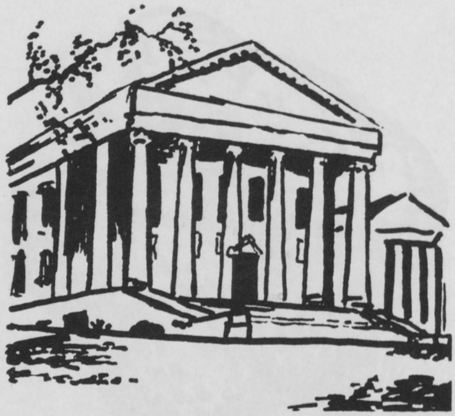
An unexpected snow and ice storm dampened our component mid-winter meeting in more than one way. Many dentists were forced to stay home and cancel their plans to attend, several dentists were forced to leave the meeting early, and those who braved the storm spent many long minutes scraping windshields free of ice and frantic moments just to get out of the parking lot.

The meeting had its bright side through the forms of Dr. Robert R. Waller and Diane Holland. Dr. Waller is director of the Dental Team program at the M.C.V. School of Dentistry and Ms. Holland is associated with J. Sargeant Reynolds Community College. Their topic was dental auxillary utilization and their lecture included how to increase office productivity, expand the duties of auxillary personnel, methods to achieve increased efficiency, and insights as to the future role of practitioners in delivering health care. For those of you who missed this meeting, much of the information will be repeated in a course to be given at the Medical College of Virginia in 1975.

Dr. Tom VanKeuren conducted a short business dinner meeting during which Dr. Jimmy Boyd related information concerning Dr. Earl Strickland's meeting of the Dental Executive Council.

Our next meeting will be held on April 8, 1974, at Petersburg General Hospital. Personnel from the department of anesthesiology and the medical staff will conduct an all day participation course in cardiac pulmonary resuscitation. Dental staff personnel are also cordially invited.

Dentists and dentistry. I want to know what's going on within my component and I want to know who's doing what. When something is happening I want to know about it. In this respect I am no different than any other dentist within our component. So please, call me when there is news that I can pass on to others. We will all enjoy reading about our colleagues and the news they're making in Component III.



COMPONENT IV

RICHMOND DENTAL SOCIETY

Francis F. Carr, Jr., Associate Editor

February has been described as the month that never ends; Component Four kept its members busy at meetings and accomplished many things during this traditionally dreary period. Dr. Manuel Marks of the School of Dental Medicine of the University of Pennsylvania gave us a thoughtful, practical, all day session on "Integrating Adult Tooth Movement into a Comprehensive Treatment Program" on February 21. He thoroughly discussed diagnosis, indications for therapy, and the difficulties in adult orthodontic patient management. At the evening meeting, our State President and Component member, Dr. Jason Lewis, along with Mrs. Pat Watkins, State Executive Secretary, informed us of VDA activities and areas of concern. The Delta Sigma Delta fraternity at MCV invited our membership to hear Dr. Abraham Hadded of the Tufts School of Dental Medicine speak February 27 on "Occlusal Adjustment, a technique and rationale as related to recent telemetric research."

Also in February, Dr. Cary Bryant of Dillwyn was instrumental in establishing an in-school program of oral hygiene instruction in Buckingham County. Sponsored by the Buckingham Jaycees, Dr. Bryant and his staff instructed all the third grade teachers in Buckingham County on proper techniques for the children to learn and on motivating them to continue these good habits. Over three hundred rural school children benefit from this program; Dr. Bryant visits the classes periodically and maintains followup training for the teachers and aides. He reports of enthusiasm in the program and of community acceptance of the effort. The project was financed by a $100.00 grant from the Richmond Dental Society. We are glad to join other Components who also sponsor community preventive programs.

In March, Dr. James Boykin, Alfred Blake Professor of Real Estate at VCU, spoke to our dinner meeting on Real Estate Investments. His wide ranging presentation covered numerous types of land dealings; his professional approach to this complex field was enlightening.

We welcome to membership Doctors Michael Glinka, Roy Oettinger, Jr., Kent Palcanis, Alan Padgett, Ralph Navon, Charles Hutchinson, Frank Angus, Bill Angus, and Jim Redwine.

COMPONENT V

PIEDMONT DENTAL SOCIETY

W. C. Williams
Associate Editor

A pilot program for controlling dental disease at the grammar school level has just been successfully completed in the Roanoke Valley. Known as Toothkeeper, with necessary aids supplied by the Dental-Eze Corp., the preventive program makes use of floss, dry brushing, disclosing tablets, and mouth mirror.

The Roanoke Valley Toothkeeper Project was instigated by Dr. Ralph Greenway of Vinton with Dr. Bill Swann of Roanoke acting as co-promoter. Endorsed by The Roanoke Valley Dental Society, and given $700 by that group, the promoters quickly raised a total of $3000 with the help of other organizations and business concerns with which to start the program.

School officials were contacted and enthusiastic approval was given for the idea. This resulted in nine schools participating at the fourth grade level, representing about 900 students (5 county schools, 2 city schools, and 2 private schools). Two four hour workshops were held to instruct the teachers and aides involved with Dr. W. M. Martin and Dr. Orin Clifton supervising the instruction. The School of Dentistry, M.C.V., sent representatives to examine the children before preventive care was begun.

At the completion of a four months period of preventive care the pupils were reexamined with a 36% decrease in gingival inflammation noted and a 27% decrease in plaque formation observed. An interesting feature is that a dry brushing technique was used—no messy dentifrice, spilt water, etc., was involved.

All parties—school officials, teachers, dentists, aides, hygienists, etc., were very enthusiastic about the program and considered the results very worth while and rewarding.

In fact, plans are being made to bring all fourth grade classes in the valley under the program next year.

COMPONENT VI

SOUTHWEST VIRGINIA DENTAL SOCIETY

David A. Kovach

Associate Editor

The spring meeting for Component Six will be held May 9 and 10, 1974. Due to the severe shortage of fuel and the long distances that some of our members have to travel to attend meetings we have eliminated the June meeting and made our spring meeting a two day affair.

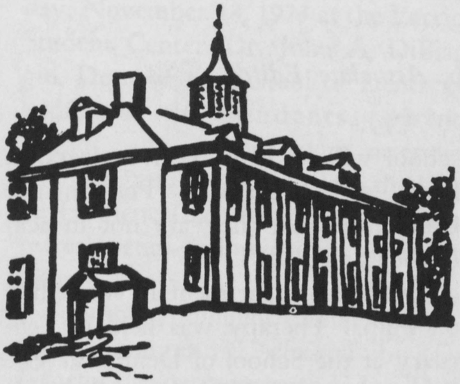
Most of the dentists in the state have received information from the Virginia Heart Association concerning the cardiopulmonary resuscitation clinics which are being held around the state during the coming months.

The spring meeting in our component is being held in conjunction with the Virginia Heart Association so as many of our members as possible can avail themselves of the training clinic. Very few of us ever encounter a severe cardiac problem or emergency in our office, but all of us should be well prepared for such an emergency.

The cardiopulmonary resuscitation clinic will be held in Blacksburg at the Marriott Motor Inn. Anyone who is not a member of our component who wishes to attend should contact Dr. David Wallace or Dr. Wallace Huff in Blacksburg. The information from the Heart Association listed the location as Marion, Virginia which was erroneous.

Several members of our component attending a course in nitrous oxide analgesia given by Dr. Kenneth Fordham. Drs. Jon Sanders, R. L. Brown, William Armentrout and myself enjoyed learning the techniques utilized in administration of medicated air (adults) or "goofy gas" (children) whichever you prefer.

National Children's Dental Health Week is now behind us, but it certainly would be advantageous if we all treated every week as if it were National Children's Dental Health Week. Prevention and attention to good oral hygiene on the part of our younger patients is so very important but it seems that we all tend to emphasize it too little. Keep prevention in mind throughout the coming year!



COMPONENT VIII

NORTHERN VIRGINIA DENTAL SOCIETY

S. Weldon Brown, Associate Editor

The Northern Virginia Dental Society met on a snowy Wednesday at the Airlie Estate in January for an all day meeting with Daniel Garliner on Myofunctional therapy. Dr. Albert Weibrecht brought the experience of fifty-eight years' practice from Wisconsin and presented the Crozat Technique of orthodontic treatment. Both areas are controversial and provided stimulation for the nearly 100 members and guests.

February saw Dr. Charles Clough driving through the snow and solving the gas situation to present an all day seminar on what to really do in an office emergency. Nearly fifty members met at the Fairfax Hospital for the meeting.

The Medical College of Virginia periodontics department came into town with their Kodachrome transparencies in tote and stayed for two days. The all day March meetings dealt with new concepts in the field of surgical periodontal therapy. Again we found it most informative in these days of prevention.

The April meeting saw members traveling to Richmond with auxillaries to learn how to cope with and how to utilize them under the expanded duties allowed by the State Board.

TRAVEL NOTES:

The two trips in February to Italy for skiing and for touring were cancelled. Several members were seen in Colorado skiing the Rockies instead of the Alps thanks to being rescued by the Canadian and North-American Medical-Dental Societies.

MCV NEWS

Dr. Felix E. Shepard, *Associate Editor*

The final phase of the revised dental curriculum at MCV will be realized by next year's senior class. Since individual students have varied needs and goals, the School of Dentistry will offer a fully elective senior year other than the clinical experience. More than forty-five elective courses and programs have been developed so that students will not have to adhere to a rigid curriculum in their pursuit of competency in particular areas of interest. Likewise, students without defined goals, and students who feel or exhibit a lack of competency in certain areas will have an opportunity to develop through their exposure to additional academic experience.

The present junior class received the elective catalogue in February. They have the opportunity to review the elective courses and programs offered by the School of Dentistry, the School of Graduate Studies and the Academic Campus. The students may elect to register for elective courses and/or repeat dental courses for remedial purposes. After the student has developed his course plan, and received approval of his faculty advisor, he will submit a course request form to the Academic Affairs Committee. At that time, review of the program and assignment of classes will be completed. Modifications of programs may have to be made by the committee in view of oversubscription to certain courses. Students interested in programs or externships outside the school will have to receive clearance from the Academic Performance Committee that they are not in academic difficulty.

An Inter-Departmental Workshop on Pulpal Therapy was held in February at the School of Dentistry. The Departments of Restorative, Pediatric Dentistry, Oral Pathology and Endodontics participated on three evening sessions in seminar and discussion groups. The program was developed by Dr. Dan Green, Chairman of the Department of Endodontics.

The objectives for the workshop were to increase inter and intra-departmental communication, to expose faculty members within the involved departments to various theories on direct and indirect pulp treatment, to discuss various therapeutic procedures related to pulp therapy for the purpose of resolving differences and understanding departmental positions and to act as an inservice training program for the faculty.

There was exhibited quite tangibly a varied degree of pro and con feeling between and within departments about when and when not to institute direct and indirect pulpal therapy. However, most agree that keen clinical judgment derived from clinical experience and empathy is essential as well as an exposure to reliable research data in the rendering of therapy.

The Division of Dental Hygiene held its Capping Ceremony for the Dental Hygiene Class of 1975 on Sunday, November 18, 1973 at the Larrick Student Center. Dr. John A. DiBiaggio, Dean of the School of Dentistry, addressed the students, parents, friends, and faculty who attended. The program was planned by the Dental Hygiene Class of 1974 who served refreshments following the presentations.

Following diligent deliberation, a search committee, chaired by Dr. George Burke, recommended to Dean DiBiaggio in January that an opportunity be afforded Dr. John W. Wittrock to become Chairman of the Department of Restorative Dentistry at M.C.V. On a second visit to Richmond, Dr. Wittrock accepted the offer effective July 1, 1974. In the interim Dr. J. Robert Eshleman, Associate Professor of Restorative Dentistry at M.C.V., has assumed the responsibilities of department chairman.

Dr. Wittrock was originally from Kansas where he earned the Doctor of Dental Surgery Degree from the School of Dentistry, University of Missouri. He later achieved a M.A. degree in Education from San Francisco State College. Following his formal education, he received the academic appointment of Instructor in the Department of Restorative Dentistry, University of Kentucky at Lexington.

Presently, Dr. Wittrock is an Associate Professor at Kentucky with a curriculum vitae to exemplify nine years of service, teaching responsibilities, research and publications which qualifies him for the position at M.C.V.

In September, 1972, the Faculty Private Practice Program began with three modestly equipped operatories and three dental assistants on the North wing of the third floor in the Wood Memorial Dental Building. Facilities were greatly expanded when the new private practice Suite was completed and opened for business in January, 1974. Lecture rooms on the South wing of the third floor were completely dismantled to provide area for the modernized suite.

The general, fully carpeted, layout provides space for five modular operatories, sterilizing alcove, waiting room, business office, consultation room, prevention area, and laboratory space. In the very near future an x-ray area will be added. Each operatory is furnished with equipment conducive to sit down, four-hand dentistry. Permeating the environment is the soothing effect of FM music which complements the general mood of the dental surrounding.

The four operatories on the North wing are utilized primarily by the Departments of Prosthodontics, and Endodontics.

There are presently six dental assistants of whom Dixie Jones, C.D.A., is the supervisor. A full-time receptionist maintains a central patient appointment book and will be responsible in the near future for a central billing and charting service.

Approximately fifty faculty members from the School of Dentistry participate in the Intra-mural Private Practice Program. Each dentist is permitted to practice a maximum of eight hours per week.

At its December 1973 meeting, the Council on Dental Education of the American Dental Association adopted a resolution to grant "preliminary provisional approval" to the J. Sargeant Reynolds Community College dental assisting and dental laboratory technology programs. The programs are physically located in the School of Dentistry, Medical College of Virginia. The dental laboratory technology program originated in September 1972 and the dental assisting program started in September 1973.

DENTAL HYGIENE CLASS OF 1975 LEFT TO RIGHT

Front Row—Josephine Scher, Susan Caudill, Joyce Birchfield, Suzanne Montgomery, Gerry Godfrey, Pamela Lindsay, Sheryl Fineman.

Second Row—Jayne Klotz, Barbara Smythe, Susan Havnaer, Janis Zimmerman, Linda Cronk, Carol Nibley, Patricia Dew, Marilyn Vergara.

Dianne Holland, C.D.A., instructs dental assisting students in clinical procedures. There are currently 15 students enrolled.

Fred C. Ulmer, B.S., M.S.A., C.D.T., directs a class of 12 students in dental laboratory technology.

VIRGINIA DENTAL SERVICE PLAN

WE POINT WITH PRIDE

The Board of the Virginia Dental Service Plan is composed of ten dentists and five non-dental members who give much volunteer time and talent in behalf of dentistry. Mr. Godfrey L. Smith, III, Chartered Life Underwriter for Mutual of New York, has served on the Board of the Virginia Dental Service Plan since 1969 and is currently Chairman of the Personnel Committee and a member of the Executive Committee. Mutual of New York recently honored Godfrey with his induction into MONY Hall of Fame.

An indication of the high respect accorded Mr. Smith can be clearly seen by the many professional groups who depend on him for advice and counsel. He is Past President of the Peninsula Association of Life Underwriters; Past President of Big Brothers of Hampton, Inc.; Past President of Mercury Lions Club; Past President of Peninsula Sports Club; President-Elect of the Peninsula Randolph-Macon Alumni Association; Chairman, Education and Training Committee for the Virginia State Association of Life Underwriters; Member of the Board of Directors of the Peninsula Chapter of Chartered Life Underwriters; Secretary of the Peninsula Estate Planning Council; State Chairman of the Membership Relations Committee of the Million Dollar Round Table; a member of the Association of Advanced Life Underwriters. He is a member of Trinity Methodist Church, Captain in Wythe Volunteer Fire Department and member of the Wythe Rescue Squad, and is Vice-Chairman of the Peninsula Salvation Army Advisory Board. He is currently serving on an advisory committee to the Virginia State Legislature on Insurance Matters and Consumer Affairs. He is the recipient of Hampton Roads Jaycees Outstanding Young Man of the Year Award for 1971. Many other honors have been accorded Godfrey Smith by his profession and community. The Virginia Dental Service Plan is indeed fortunate and honored to have him as a member of its Board of Directors.

REPORT OF EXECUTIVE COUNCIL MEETING

January 6, 1974
Hotel John Marshall
Richmond, Virginia

EXECUTIVE COUNCIL SUMMARY IN BRIEF...

1. *Approved* appointment of Bank of Virginia-Potomac as Corporate Trustee of the Balanced Retirement Plan Trust.
2. *Approved* authorization of a Pension Committee to serve as advisors to Trustee and Administrator of Balanced Retirement Plan Trust.
3. *Approved* that Component Patient Relations Committees send to Executive Committee by May 1, 1974 breakdown on complaints received, and that Chairmen of Patient Relations Committees meet at June Committee meetings.
4. *Approved* increase in mileage allowance from 10¢ to 15¢ a mile for officers.
5. *Approved* June 1 and June 2 as dates for VDA Committee and Executive Council Meetings, to be held at Mariner at Virginia Beach, or if energy crisis makes it advisable at the John Marshall in Richmond.
6. *Approved* two-weeks South American Adventure to Quito, Buenos Aires, and Rio de Janeiro and two-weeks Orient Adventure to Tokyo and Hong Kong for 1975, as proposed by INTRAV.
7. *Received* Report of State Board of Dentistry.
8. *Approved* that VDA support amendment of § 54-175, Issuance of license to practice, as proposed by the State Board of Dentistry.
9. *Approved* that VDA legal counsel investigate structure of State Health Department to determine, if possible, that Dental Division can become autonomous, answerable to Commissioner of Health.
10. *Approved* establishment of a membership category for Retired Dentists at reduced membership fee of $25 per year.
11. *Approved* Advisory Committee's recommendation to Constitution and Bylaws Committee that membership of Advisory Committee be increased to 9 members.
12. *Approved* recommendation of Advisory Committee that VDA continue to elect 7 ADA Alternate Delegates and that they be reimbursed on same basis as ADA Delegates.
13. *Approved* that action be delayed until next meeting of VDA House of Delegates on two 1973 adopted resolutions concerning changes in Dental

Practice Act to allow for election of members of Board of Dentistry by all registered dentists and to add at least two additional dental members to the Board.

14. *Received* Report of MCV School of Dentistry.
15. *Approved* that letter be sent from Executive Council to Chairmen of Senate Finance and House of Delegates Appropriations Committees in support of 1974-76 MCV School of Dentistry budget request.
16. *Approved* sending to VDA House of Delegates, without recommendation, resolution of Continuing Education Committee requesting authorization for State Board of Dentistry, in conjunction with Committee, to prepare a resolution pursuant to institution of mandatory continuing education requirements for relicensure.
17. *Tabled* action on Medicaid Program participation until June 2, 1974 meeting of Executive Council.
18. *Approved* Dental Education Committee's recommendation for 1974 Dental Extern Program.
19. *Approved* that 1974 Senior Dental Students Luncheon be held.
20. *Approved* recommendation of Financial Investments Committee that VEPCO Preferred Stock be sold and proceeds plus 1973 surplus be placed in Certificates of Deposit.
21. *Approved* recommendation of Hospital Dental Service Committee that Blue Cross-Blue Shield Liaison Committee be expanded to include representatives from all specialty fields and not less than two persons engaged in practice of general dentistry.
22. *Received as information* progress report of Peer Review Committee.
23. *Received as information* Public Information Committee's report concerning progress being made in the continuing In-the-Classroom Program of Preventive Dental Education for Children.
24. *Received as information* report of the Dental Trade and Laboratory Relations Committee.
25. *Approved* that Continental Casualty Company be requested to increase Major Medical maximum benefit from $100,000 to $250,000 and offer $15,000 deductible plan, effective February 15, 1974.
26. *Received as information* report of the Student Loan and Scholarship Committee.
27. *Approved* that Committee Chairmen and representatives be thanked for time and effort put forth on meetings.
28. *Received as information* report on financial aspects of Delta Dental Plan and ADA's purchase and resale of Delta Plan's stock.
29. *Approved* that 1974 Annual Meeting Presidential Banquet be programmed as "Honoring Dr. and Mrs. Jason R. Lewis."
30. *Received as information* report of ADA 1973 Annual Session.

DENTAL MEDICAID

by R. L. Kiefer, D.M.D.

Because of the misunderstanding and misinterpretation voiced by some of the dentists of Virginia, the next series of articles will address those concerns that have been brought to the attention of the Medicaid Dental staff, and an attempt will be made to resolve them.

CONCERN: Specialists are receiving higher fees than general practitioners for the same services.

FACT: The Medicaid Dental Program reimburses for services regardless of the performing practitioner according to each practitioner's usual and customary charges as submitted to the Program.

CONCERN: Certain dental procedures are limited and can only be practiced by specialists.

FACT: The Medicaid Dental Program recognizes that Virginia's Dental Laws allow a licensed dentist to perform any service within the scope of his license. Coverage or exclusion of any dental service is determined by the nature of the service alone and is not affected by the professional designation.

CONCERN: Participating dentists are only receiving 75% of their usual and customary fees.

FACT: The Medicaid Dental Program established its allowable fee schedule by obtaining the usual and customary fees from each enrolled provider on a geographic basis. The Program reimburses the practitioner's usual and customary charges up to the 75th percentile of the fees submitted by his peers.

CONCERN: The Dental Medicaid Advisory Committee is not representative of dentistry in Virginia.

FACT: This committee is made up of representatives from the Virginia Dental Association, the Old Dominion Dental Society, the Medical College of Virginia School of Dentistry, the State Health Department, the Board of Dentistry and the Medicaid Dental Program.

CONCERN: There has been no effort to inform the public of the dental program.

FACT: When the Medicaid Dental Program began on July 1, 1973, news releases were sent to all the major newspapers in the state. In addition, when Program recipients receive their Medicaid cards, they are advised of their dental benefits by means of an insert that explains the Program. This began July 1, 1973, and remains in effect.

The computer kickbacks resulting from forms being improperly filled out are lower than the medical portion of the Program even though it has been in operation for several years. Chapters V and VI of the Medicaid Dental Manual have been revised and soon will be in the hands of the providers. This will clear up many of the problems providers have had in the past in filling out the forms. Medicaid also has Program representatives who have the primary function of calling on our providers when problems occur. All that is required for these services is a call to the Medicaid Dental office.

Considering the complexity of the Medicaid Dental Program and the fact that it is an entirely new concept to the members of the dental profession, it may be said that the Program is functioning smoothly and is accomplishing the task for which it was originally designed. This task is to provide dental care to Medicaid recipients under twenty-one years of age for whom these services might not otherwise be available.

The outlook for Medicaid Dental is optimistic, and its staff stands ready to assist all dentists with any problems that may arise.

READY FOR THIS?

"Doctor, if you had only told me that the medicine was so dangerous, I would have kept it locked away from my children."

Are you ready to hear that?

One of the most common medical emergencies among children is the accidental ingestion of substances around the home, particularly medicines.

In 1972, more than 160,000 cases of accidental ingestions were reported—the majority involving children under 5 years of age. Estimates are that only one in seven is reported, making the actual number close to a million a year.

Dentists in particular, knowing the psychology of the mouth, can explain why. Parents will be grateful to you for presenting this information to them when you prescribe medicines for them or for their children.

Children from the time of their birth experience oral gratification. Bottle and breast feeding are only the early factors in the developmental patterns that place emphasis on the mouth.

The infant grabs someone's finger—and into the mouth it goes. A baby rattle, almost any plaything, ends up the same way.

It is no surprise, then, that an infant starting to crawl finds things beneath the kitchen sink or near the bathroom floor which end up in his mouth and are often swallowed.

The toddler, able to stand, can reach pills inadvertently left on the nightstand or an open purse left on the bed.

The young child who has learned to climb has the medicine cabinet within reach—and the aspirins, the drugs and other medications.

Counseling parents on the dangers of misusing medications should include information on the rearrangement of storage. Most bathroom medicine cabinets do not have locks. Better alternatives are lockable cabinets, drawers, linen closets and even fishing tackle boxes. Further:

—Medicines should never be referred to as "candy."

—Parents should not take medicines in the presence of children. Children are notorious imitators.

—Medications should be disposed of after the condition for which they are prescribed has passed.

—Dark rooms are no place to give or take medicines.

—Labels should be read paying close attention to recommended dosages. And always, medicines should be kept in the correct containers.

—Medicines should never be set aside while you answer a telephone or the door.

You can insist that your pharmacists place medications you prescribe in new safety containers which are now standard. It is essential that your patients not ask pharmacists to substitute conventional-type packages unless some condition, such as arthritis, requires it.

In order to be "child-resistant," the container must be effectively closed after use. In most cases, this is a matter of properly closing the cap.

Safety packaging is not a "cure-all" for poisoning. The container is only expected to keep the contents secure from most children. Some children, because of their ingenuity and manual dexterity, will succeed in opening the package.

National Poison Prevention Week was observed March 17-23. It is a good time to re-examine our prescribing procedures to be certain we are doing our part to help prevent accidental ingestions.

FDI MEETING IN LONDON 1974

The British Dental Association is to be host to the 62nd Annual World Dental Congress of the Federation Dentaire Internationale which will be held at the South Bank Arts Centre in London from Sunday, September 8, to Saturday, September 14, 1974. Her Majesty Queen Elizabeth II has graciously consented to be Patron of the Congress. FDI business and Commission meetings will be held at the Waldorf Hotel, London, from Tuesday, September 3, 1974.

Scientific Programme

The main theme of the scientific programme is "The Dentist's Role in a Changing Society," which will be examined in more than purely dental terms during three morning sessions of the Congress. The first session will be devoted to "Society's Expectations of Dentistry," the second to "Current Attempts To Satisfy Society's Needs," and the final session will consider "Meeting the Challenge of a Changing Society." Distinguished speakers from all parts of the world are being invited to contribute to the main theme, but individual dentists may take part in the scientific programme in the free communication sessions and in the presentation of table demonstrations, films and video-tapes which are a large and important feature of the Conference.

Social Programme

To allow those attending the Congress to meet and relax in interesting surroundings, cocktail receptions will be held on the first evening of the Conference in several of London's historic buildings. On the Monday evening of the Congress there will be a visit to a musical show at the famous Drury Lane Theatre. A special Congress Symphony Concert will be presented at the Royal Festival Hall by the New Philaharmonia Orchestra with the celebrated pianist, John Ogden, as soloist. And since no visit to London would be complete without a trip on the River Thames, evening excursions on river boats have been arranged, to allow visitors to see the glittering lights of London by night, while dining and dancing on board. The FDI Supporting Members' Ball will be held on the Thursday evening at two of London's famous hotels, and many other receptions will be arranged by various societies and institutions in London.

Enrollment

Provisional Programmes and application forms can be obtained on request from FDI, '74 Congress Office, Conference Services, Ltd., 43 Charles Street, London W1X 7PB, U. K. Information on the scientific programme may be obtained from the Organizing Secretary, 64 Wimpole Street, London W1M 8AL, U. K.

The London Organizing Committee hopes that dentists throughout the world will find this programme attractive. They look forward to meeting and entertaining you in London in 1974.

(*Continued from page 17*)

jaws by interstitial growth between the incisor and canine determinant, and the canine and molar determinants, respectively (Fig. 7B to E). This accounts for the sequences in which teeth develop in these regions: just as in reptiles, a new bud is initiated when the presumptive tooth-forming tissues have escaped from the inhibitory regions generated around a developing tooth. For the same reason the permanent molars develop in front-to-back sequence as space becomes available posteriorly in the growing jaws. However, it will be noted that no explanation has yet been offered for the early appearance of the three determinants. In terms of development I have no data or solution to this problem; any sequence appears possible, including all three arising at the same time. But if ontogeny can be compared with phylogeny, the canine is the most likely to be initiated first.

Dentition in mammal-like reptiles

Before suggesting how mammalian dentitions may have evolved it is necessary to look at data for the mammal-like reptiles which bridged the gap between reptiles and mammals. Obviously we can only surmise the sequences in which teeth were initiated in embryos of these animals, but given a complete enough growth sequence it is possible to deduce the sequences in which teeth were replaced. And it so happens that there is a good growth sequence of the early Triassic mammal-like reptile *Thrinaxodon*, which is generally believed to have been close to the line of mammal evolution.

Both the pre- and postcanines in the small, almost certainly carnivorous *Thrinaxodon* were replaced in waves which swept through alternate tooth positions: the large canine was regularly replaced. To this extent *Thrinaxodon* had a dentition like that of a homodont reptile, with the exception that it had evolved a canine tooth. However, the postcanine dentition was graded anteriorly from rather simple conical teeth (but more complex than those of the earlier reptiles) to complexly cusped posterior teeth (Fig. 8). *Thrinaxodon's* heterodont postcanine dentition makes it an important link between reptiles and mammals.

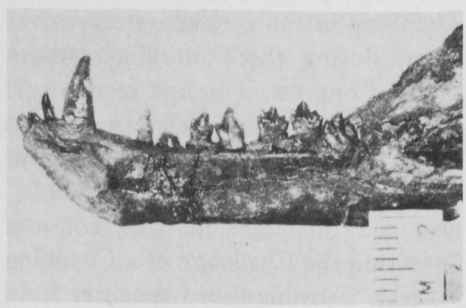


Figure 8

No matter what size of *Thrinaxodon* jaw is studied it nearly always contains a developing or erupting tooth at the back of the dentition. This also is like a primitive reptile. But despite the constant addition of new tooth families, no dentition seems to contain more than about 7 postcanines (6 or 8 may be present). The answer to this problem is that when a tooth was added to the back of the dentition, one was generally lost from the front of the postcanine dentition (*23*).

The 7 postcanine teeth of *Thrinaxodon* consist of 3 different tooth types referred to as P, M, and A types (*4*) (Fig. 8). These symbols represent posterior, middle, and anterior, the positions in which the different tooth types are invariably situated. Because new P types were always erupting at the back of the dentition, while A types were being lost at the front, it might seem that an old animal would have possessed a postcanine dentition consisting entirely of P types. But in fact all jaws contain about 3 A types followed by 2 M types, 2 P types, and an erupting P type. The way in which this dentition was probably maintained is shown in Figure 9.

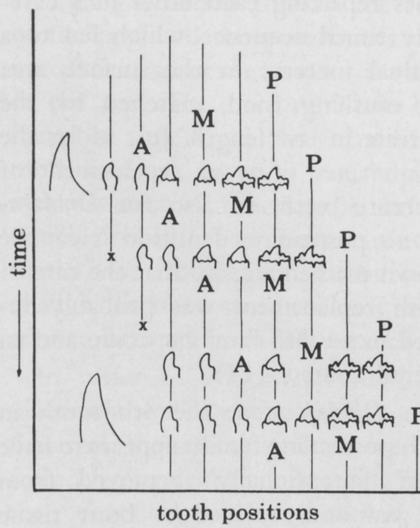


Figure 9

Every postcanine tooth position was successively occupied by P, M, and A types. This result provides excellent support for the concept that the tooth family is the unit of dentitions, the postcanine unit being a P, M, A sequence. Furthermore it is also clear that tooth replacement in *Thrinaxodon* served to increase the size of the teeth in the dentition so that they would match the size of the growing jaw and the requirements of the growing animal.

Diademodon, a gomphodont cynodont of the Triassic, also had a heterodont postcanine dentition in which teeth were probably constantly being replaced in response to the requirements of the growing animal. Each of 20 or more postcanine tooth families sequentially added to the back of the dentition contained 6 different tooth

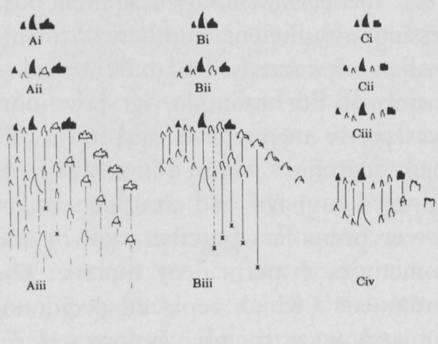


Figure 10

types replacing each other in a carefully timed sequence which led to a gradual increase in the surface area for crushing food, matched by the increase in jaw length. Just as for the maintenance of wave replacement of alternate teeth, so also for *Diademodon's* postcanine dentition it can be shown mathematically that the rate of tooth replacement was probably related to a tooth family specific and an overall control (*24*).

In *Diademodon*, the 6th tooth in each postcanine family appears to have been "intentionally" removed from the jaw and replaced by bony tissue called a plugged socket. Increasingly large replacement canines encroached on the potential space created at the front of the postcanine dentition. However, in *Thrinaxodon* it seems possible either that anterior postcanine families were finally suppressed owing to the proximity of developing canines (*25*) (Fig. 9) or that the families were more intentionally lost, as in *Diademodon*.

There remains the evidence of the Upper Triassic (Rhaetic) *Eozostrodon*, the earliest known animal possessing a sufficient number of mammalian characteristics to be called a mammal. For example, its jaw joint was partly mammalian, and it was almost certainly diphyodont (*26*). It appears to have had 5 upper and 4 lower premolars together with 4 and sometimes 5 permanent molars. The premolars (which replaced deciduous molars) were themselves lost and replaced by plugged sockets like those of *Diademodon*. Rather surprisingly, some molars also appear to have been replaced by plugged sockets in older (larger) animals (*26*).

From the Upper Triassic through to the Tertiary there is remarkably little data on tooth replacement in mammals. However, as will now be shown, we have sufficient data from the above animals, together with the data on recent reptiles and mammals, to be able to outline a plausible sequence in which the dentitions of mammals evolved.

Tooth initiation in submammalian vertebrates

In the earliest vertebrate dentitions which have so far been studied, teeth appear to have been replaced in waves which passed from the back to the front of the jaw. It seems probable that these teeth were initiated in the same sequence as those of *L. vivipara* (*10*). The sequence is shown in Figure 6, and the adult pattern of tooth replacement is the same as that of the hatchling (Fig. 5D). Although the regularity of the replacement waves shows little trace of the sequence in which tooth families were initiated in the embryo, it is evident that there is an important difference between the alternating sequence in which families were initiated in front of the dental determinant and the sequential initiation of families behind the dental determinant (Fig. 6).

Wave replacement of alternate teeth in front of the dental determinant was initiated before any teeth were replaced (rows a and b in Fig. 6): it was the outcome of the alternating sequence in which families were initiated in this region. But the rate of tooth replacement needed to be controlled in order for wave replacement of alternate teeth to develop between the sequentially initiated families behind the dental determinant (11a, 12b, 13c, 14d, 15e in Fig. 6). And a more widespread overall control of tooth replacement was required for the waves passing through the families behind the dental determinant to blend into the waves already present in front of the dental determinant (*16*).

The earliest heterodont dentitions often contain one or two enlarged teeth in the middle, or anterior to the middle, of the maxillary bone: for example, the Carboniferous reptile *Hylonomus* and the upper Carboniferous captorhinomorphs. The same is true of the Permian pelycosaurs. What was the most probable sequence of tooth initiation?

In terms of function the jaws were by now separated into three distinctly different regions. The precanines captured food, the canine was a weapon, and the postcanines immobilized prey or food prior to swallowing. It seems likely that teeth were replaced at a different rate in each region; in particular, the large canine would have been more slowly replaced because it took longer to develop. It is surely more probable that these differences in function and the rate of tooth replacement would evolve from, rather than be separately superimposed on, the pre-existing dental asymetry present in embryos of the homodont ancestors. In other words, the canine evolved at the site of the dental determinant, the precanines were initiated in alternation toward the front of the jaw, and the postcanines were initiated in sequence toward the back of the jaw. This may not have been the only site at which a caniniform tooth evolved, but it is certainly the most satisfactory functionally and one which probably had the greatest potential for subsequent evolutionary change. To understand this it is necessary to turn again to *Thrinaxodon.*

In order to understand tooth replacement in *Thrinaxodon* we must first seek the selective advantage conferred by its dentition. It seems likely that, together with the canine, the simple A types found toward the front of the postcanine dentition either punctured or held prey. The shape of the P types indicates that their primary function was not to hold or puncture struggling prey; A types would have been more efficient for this purpose. What seems possible is that these teeth were used to crack bones. For this purpose a moderately serrated surface was required in order to prevent the bone's slipping (large spaces between slender cusps or teeth, such as between the A types, would have been much less efficient), and the bone-splitting teeth needed to be sited where maximum jaw power could be developed. In order to break bones it did not matter that the upper and lower cheek teeth could not be brought together (as in most reptiles). However, it was necessary that the P types should be firmly rooted (as are all the teeth in *Thrinaxodon*). The intermediate M types could function either with the A or P types.

It is not difficult to visualize how

the dentition of *Thrinaxodon* might have been initiated. The canine remained the dental determinant separating two developmentally different jaw regions. The families within the precanine region were still initiated in alternation toward the front of the jaw, and those in the postcanine region might still have been initiated in sequence toward the back of the jaw (but see below). The major innovation was the distinct change in shape of successive teeth in each postcanine family. This evolutionary step will now be considered.

Changes in shape

In many recent Lacertilia the earlier members of each more posterior family (perhaps those behind the dental determinant) have rather small anterior and posterior accessory cusps situated on the flanks of the major cusp (27). The posterior and then the anterior cusps are gradually lost by successive replacement teeth, with the result that the tooth families now produce unadorned conical teeth. It can be visualized that, owing to the presence of incipiently tricuspid teeth, the short dentitions of the young are relatively more serrated than the longer dentitions of the adult. Presumably the 3-cusped teeth of the young have the advantage that fewer are required to produce the same number of grasping serrations as simple conical teeth.

The above type of dentition in which the accessory cusps of hatchling teeth are gradually lost by successive replacement teeth is exactly what might be predicted for an ancestor of *Thrinaxodon*. Those animals with larger accessory cusps were selected for in successive generations, with the result that the complex P type evolved. However, in conformity with its ancestors, successive replacement teeth were less complex. Indeed the maintenance of this characteristic had a selective advantage because it resulted in the anterior, and therefore older, postcanine families containing puncturing conical teeth, while the newly initiated posterior families contained complex "crushing" teeth.

It was now an advantage to reduce the rate of tooth replacement in the postcanine region. Too rapid a rate of tooth replacement would have resulted in the rapid loss of crushing P types and a postcanine dentition which contained nearly all puncturing A types. However, too slow a rate of tooth replacement would have resulted in too few A types anteriorly.

It will be noted that the above evolutionary step implies that the tooth family with its P, M, A sequence was a genetic unit of *Thrinaxodon's* dentition. If one postcanine family was changed then all postcanine families were changed. In terms of morphogenetic "coding" it was possible to evolve differences between precanine, canine, and postcanine families by taking advantage of the fact that each of these major units was contained in a developmentally different part of the jaw. However, the following analysis suggests that the anterior postcanine families in *Thrinaxodon* may have differed from the posterior postcanine families. The data to support this suggestion come from *Diademodon*.

The evolution of a molar determinant

It will be recalled that most of the 20 or so postcanine families in *Diademodon* each contained 6 teeth. However, a very small (very young) *Diademodon* jaw contains 5 postcanine teeth, which are the 5th, 5th, 5th, 5th (gomphodonts), and 4th (intermediate gomphodont) teeth, respectively of the 6-tooth sequence. Due to the very small size of this jaw, the implication is that, unlike the remaining postcanine families, the anterior postcanine families did not develop the first 2 or 3 replacement teeth (*28*). The absence of these earlier teeth from the anterior postcanine positions would have been an advantage because the 5th tooth in the 6-tooth sequence, the large grinding gomphodont, appears to have been the most useful postcanine tooth: a newly hatched (probably herbivorous) *Diademodon* whose short postcanine dentition contained only the first 3 teeth in the 6-tooth sequence, which were slicing (sectorial) teeth, would have been unable to grind food.

Suppose that a newly hatched *Thrinaxodon* also required a miniaturized version of the adult dentition—say, a P type in postcanine position 3, M type in position 2, and A type in position 1. If all postcanine families were alike, this would have required P and M types from position 1 and an M type from position 2 to have been developed and lost before hatching. One way to achieve this would be to initiate the anterior P types at a stage before the dental tissues were competent to lay down mineral. In other words, the relevant buds were coded for P types but regressed like the earliest developed buds in *L. vivipara*. However, it seems possible that another method may have been evolved.

Although this is not the place for a detailed discussion of the determination of tooth shape, it is necessary to draw attention to the fact that the (mesodermal) dental papilla rather than the (ectodermal) enamel organ of tooth germs is probably responsible for determining tooth shape in mice (and presumably all mammals) (*14*). For example, an incisor enamel organ grafted onto a molar dental papilla produces a molar tooth. Even small fragments of enamel organ or lip ectoderm grafted onto a papilla result in the formation of a tooth whose shape is the presumptive shape of the tooth germ from which the papilla was taken. Therefore tissue derived from the jaw mesoderm probably determines the shape of a tooth. This suggests that the changes in jaw mesoderm responsible for sequentially producing the P, M, and A types in each postcanine family of *Thrinaxodon* were triggered by the initiation or development of the preceding tooth type.

Suppose that *Thrinaxodon*, like recent mammals, possessed a molar determinant—in other words, that the 3rd postcanine family was initiated adjacent to the canine and that the 1st and 2nd tooth families were initiated in succession, following interstitial growth between the canine and molar determinants. Just posterior to the canine, jaw mesoderm generated the P-type shape of the molar determinant

(Fig. 10Ai). This newly differentiated jaw mesoderm was not only responsible for generating the papilla of the replacement for this P type but also, by interstitial growth of the jaw, for generating the papilla of the tooth anterior to the molar determinant which was therefore also an M type (Fig. 10Aii).

Jaw mesoderm which had generated an M type was triggered to continue by generating an A type. Therefore, further interstitial jaw growth resulted in the formation of an A type in the newly initiated family posteriorly adjacent to the canine. Thus the 3 anterior postcanine positions of the hatchling would be occupied by A, M, and P types, respectively, without any tooth having been replaced. Each family continued by developing the next tooth in the P, M, A sequence (Fig. 10Aiii). However, the anterior postcanine families sometimes replaced A types with even more diminutive teeth (*4*). The above explanation carries the implication that tooth families are the genetic units of dentitions. It should be noted that, behind the molar determinant, P types started molar families because the associated mesoderm was newly differentiated.

The above technique may or may not have been evolved by *Thrinaxodon;* juvenile *Thrinaxodons* were so small that it is unlikely sufficient numbers will ever be found to test the theory. It is even less likely that sufficient early mammals will be found, because although *Thrinaxodon* was not large it was a giant compared with *Eozostrodon* (*26*), the earliest undoubtedly diphyodont animal. It took over three years of sifting through a truckload of rubble to find the 4 or 5 jaw fragments (the largest being about ½ cm long) that firmly established the diphyodont nature of *Eozostrodon* (*26*). It is therefore unlikely that we will ever find much evidence for the sequences in which the teeth of early mammals were replaced, let alone initiated. But it seems improbable that postcanines were initiated in sequence from the front to the back of the jaw, as Ziegler has suggested (*20*), not only for Mesozoic but also (contrary to the data which are available) for recent mammals.

This is not the place for a detailed discussion of fossil data, which are so limited that they could probably be used to support several theories. But if the concept of a molar determinant is accepted, it is possible to explain most of the available data for recent and extinct mammals. Reduction in the rate of tooth replacement can account for the diphyodont nature of *Eozostrodon's* dentition (Fig. 10B). Just as in *Thrinaxodon*, the anterior postcanines were initiated in sequence anteriorly in front of the molar determinant, and the morphological gradient was similar. The premolar sockets were plugged, usually in sequence from the front of the jaw, but occasionally more irregularly (*26*). It may be that the 1st deciduous molar was not replaced, as in recent mammals, accounting for its early plugging (c.f. the 1st postcanine in *Thrinaxodon*). Further irregularities could be accounted for if Dm4, rather than Dm3, was occasionally the molar determinant, implying variation in interstitial jaw growth. The decrease in number of molar families as compared with *Thrinaxodon* was related to a reduction in posterior jaw growth.

Further increase in interstitial jaw growth between the canine and molar determinants, together with the loss of one or two molar families from the back of the dentition, can account for the sequence of tooth initiation in recent eutherian mammals (Fig. 10C). The eutherian postcanine dentition may have evolved by a progressive increase in interstitial jaw growth together with loss of molar families.

The precanines

We now return to the sequences in which precanines were initiated. Because in *Thrinaxodon* the precanines were alternately replaced, like those of its ancestors, it seems probable that they were also initiated in alternate sequence from back to front, also like those of its ancestors (Fig. 10A). The incisors of recent eutherian mammals are generally initiated in sequence from the front to the back of the jaw. However, in a recent marsupial it appears that, of the 5 upper incisors, I1 and I5 are the last to be developed *(29)*. For convenience I have incorporated this latter sequence in the dentition of *Eozostrodon* (Fig. 10B), although this animal had 4 lower incisors *(26)*. Thus I3 was the incisor determinant; I4 and I5 were initiated in a region of interstitial jaw growth and I1 and I2 in a region of anterior tip growth. In terms of what is biologically possible, this is no more difficult to accept than the equivalent evolution of a molar determinant. But just as for the molar determinant, so also for the incisor determinant it is necessary to find a selective advantage for the new sequence in which incisors may have been initiated.

Although there can never be any supporting evidence, it seems possible that the earliest newborn mammals would have become firmly attached to the mother's nipple, rather like recent metatheria, but that when released from the nipple they would immediately have had to forage for themselves. Intermittent suckling on demand would probably have evolved separately and later. If this is true, just prior to being released from their mother's nipple the earliest infant mammals, like newly hatched reptiles, would have required a functioning dentition. Apart from the anterior incisors, all the teeth could have erupted before the infant was released because they formed the side walls of a tunnel which surrounded the nipple. But eruption of the anterior incisors must have been delayed in order to provide the space through which the nipple entered the mouth.

It is of interest here that Mills *(30)* states there is a particularly large midline diastema between the upper incisors of *Morganucodon* (= *Eozostrodon*). If this is true, then the requisite space for the mother's nipple may have been provided by inserting it between the position of the lost upper anterior incisors (suppressed during evolution) and the procumbent lower anterior incisors.

It is evident that the sequence of incisor eruption implied for *Eozostrodon* (Fig. 10B) would have allowed the anterior incisors to erupt after the remainder of a functioning dentition. The evolution of this sequence is no more difficult to accept than that given for the evolution of the molar determinant. It will be noted that in both cases the teeth initiated following interstitial jaw growth were initiated and erupted earlier than those initiated following tip growth.

There would now have been a selective advantage for evolving different suckling periods which were matched to the physical development of different species of infant. Too short a time would have led to the wasteful death of many infants that were incapable of foraging for themselves. This led to the evolution of a behavior pattern which permitted suckling on demand by an infant that had earlier been released from the nipple. However, too long a suckling time would have involved the mother in wasting energy on suckling infants that were physically capable of foraging for themselves; in terms of selective advantage the energy would have been better employed in breeding a new generation.

This latter argument can account for the evolution of the eutherian incisor formula and pattern of tooth eruption. By prolonging the time *in utero*, the eutherian infant was better protected than the metatherian infant. Since all suckling is intermittent in eutherian mammals, it was an advantage to erupt the incisors as early as possible in order that the infant could supplement its milk diet. Provided the mother continued to permit suckling until the infant was capable of foraging enough food by itself, those infants (presumably insectivorous) possessing an uninterrupted span of incisors at the front of the jaw would have had a selective advantage when foraging. This ultimately led to the loss of the 2 late-developed anterior incisors, with the result that the earliest initiated (and erupted) incisor, the incisor determinant, became sited towards the midline of the jaw (Fig. 10C) and the ancestral 2 anterior incisors were lost.

"Irregular" sequences

Now that we have arrived at the earliest eutherian dentition consisting of I3, C1, Pm4, M3, it is worth summarizing how the initiation of such a dentition may be controlled. The embryonic jaws of mammals contain three major developmental segments: incisor, canine, and molar segments. Each segment is provided with genetic coding for a paradigm tooth shape. A first tooth, the determinant, appears in each of the three developmental segments at about the same time during development. Each generates around it a zone of tissue in which further initiation of teeth is inhibited. The incisor and molar jaw segments (not the canine segment) are potentially capable of expanding anteriorly and posteriorly, thereby generating new jaw tissue for the initiation of further teeth. However, tip growth of the incisor region has been suppressed in most eutherian mammals, with the result that the most anterior incisor is the incisor determinant and I2 and I3 are developed following interstitial jaw growth between I1 and the canine.

The molar region grows both by expansion between the canine and molar determinants, which provides space for deciduous molars to be initiated in sequence forward, and by expansion posteriorly, which provides space for the permanent molars in sequence posteriorly. Successive dental papillae derived from a single colony of jaw mesoderm retain successively less ability to generate the paradigm molar shape, with the result that they are less complex. Thus Dm3, Dm2, and Dm1 are progressively less complex because they are derived in ("horizontal") sequence from jaw mesoderm which has already generated Dm4. And for the same reason their ("vertical") replacements, the premolars, are even less complex. The permanent molars are sequentially initiated in newly differentiated jaw mesoderm behind the molar determinant. Therefore each has a shape which is closer to that of the paradigm molar than the deciduous molars are.

We can now give an explanation for the irregular sequences in which the teeth of eutherian mammals erupt. The irregularity is due to the existence of four developmental regions: the incisor, canine, and anterior and posterior molar regions. Within each region the teeth develop in sequence. For example, if we number the 8 deciduous teeth and 3 permanent molars of the mole in sequence from the front to the back of the jaw (i.e. the teeth in the first mammalian *Zahnreihe* of Edmund), they are initiated approximately in the sequence 1, 4, 8, 7, 2, 6, 3, 9, 10, 5, 11 (*31*). When separated into developmental regions, the sequences are 1, 2, 3 (the deciduous incisors); 4 (the canine); 8, 7, 6, 5 (the deciduous molars); 9, 10, 11 (the permanent molars). It is only because all four regions are developing at the same time that the integrated sequence appears to be so irregular.

In a later paper (in preparation) many of the irregularities in mammalian dentitions will be discussed. The present model suggests that several currently accepted tooth homologies may not only be inaccurate but also very misleading in evolutionary terms. For example, if the above explanations are accepted, the molar determinant is presumably homologous between different dentitions. In many primates the so-called Dm3 (the penultimate deciduous molar) is the molar determinant. If this tooth is homologous with the ancestral molar determinant, it should be designated Dm4, in which case the ancestral M1 is now replaced by a Pm5. However, this heresy will be shelved for the present.

J. W. Osborn is a Reader in Anatomy in relation to Dentistry at London University. Following his dental degree he obtained the Fellowship in Dental Surgery of The Royal College of Surgeons while building a part-time dental practice. However, in 1964 he became a full-time anatomist, his major research interest being the structure and development of tooth enamel. He has recently published a lengthy review of his work in this field. In 1969 he began investigating the evolution of enamel but changed his interest when F. R. Parrington, of Cambridge University, and A. W. Crompton, of Harvard University, (with whom he now works "across the pond") explained to him the intriguing problems involved in changing from a reptilian to a mammalian dentition. In 1971 he was appointed Visiting Agassiz Pro-

fessor in Vertebrate Paleontology at Harvard University. He is currently engaged in the problem of the controls required to develop the shapes of teeth—once more leaning on paleontology. The author wishes to thank Andrew Sita-Lumsden for many fruitful discussions. *Address: Anatomy Department, Guy's Hospital Medical School, London Bridge SE1 9RT, England.*

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HAVE YOU HEARD THE LATEST ABOUT THE BEES AND THE FLOWERS? . . . . . .

"Said a wise old bee at the close of day, 'The colony business does not pay. I put my honey in that old hive that others may eat and live and thrive; And I do more work in a day, by gee, than some of the other fellows do in three. I toil and worry and save and hoard, and all I get is my room and board. It's me for a hive I can run myself, and me for the sweets of my hard-earned pelf.'

So the old bee flew to a meadow lone and started a business of his own. He gave no thought to the buzzing clan, but all intent on his selfish plan, He lived the life of a hermit free—'Ah, this is great,' said the wise old bee.

But the summer waned and the days grew drear, and the lone bee wailed as he dropped a tear; For the varmints gobbled his little store and his wax played out and his heart was sore; So he winged his way to the old home band and took his meals at the Helping Hand.

Alone our work is of little worth; together we are the lords of the earth; So it's all for each and it's each for all—united we stand, or divided fall."

Be(e) Wise, *Sunshine Magazine*, August, 1973

Questions from consumer groups and increasingly burdensome governmental regulations indicate to us that there is an immediate need for clarifying some facts and exposing misconceptions regarding the professions and professional services. For this reason it is vital this very year that we stand together to work for improving the professional image before it is undeservingly toppled.

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(*Continued from page 24*)
probably the same as those of the stannous fluoride solutions and prophylactic paste. It has been postulated that sodium monofluorophosphate reacts with enamel to produce some form of calcium fluorophosphate or apatite fluorophosphate.

The degrees of effectiveness of fluoridated dentifrices appear to be directly related to the frequency of their use. Increased frequency of brushing with these dentifrices appears to increase the degree of cariostatic protection. When used by children, the stannous fluoride dentifrice and the sodium monofluorophosphate dentifrice appear to be equally effective. Several reports[67–75] have indicated 15% to 30% reductions in the incidence of dental caries when the stannous fluoride dentifrice was used by children consuming fluoride-deficient, as well as optimally fluoridated water. At least three reports[56, 76, 77] have indicated that the stannous fluoride dentifrice provides cariostatic benefit when used by adults. Similar percentage reductions in dental caries incidence among children using the sodium monofluorophosphate dentifrice have been reported[75, 78–82]. One of these studies[75] was conducted in a community with fluoridated water. There appears to be a lack of clinical studies evaluating the cariostatic effect of the sodium monofluorophosphate dentifrices among adult subjects.

In addition to these two dentifrices, another commercially available dentifrice containing sodium fluoride*** has been the subject of extensive study in recent years. Since there is some indication that this product may reduce the incidence of caries in children, it is possible that it may be approved by the Council on Dental Therapeutics in the near future.

MULTIPLE FLUORIDE THERAPY

It is obvious that no single fluoride treatment procedure is totally effective in eliminating the development of dental caries. Therefore, the maximum cariostatic benefit for patients can probably be attained through use of a multiple fluoride therapy approach. It has been suggested that this multiple approach should consist of: (1) communal water fluoridation; (2) the semi-annual application of a stannous fluoride prophylactic paste, immediately followed by; (3) semi-annual topical application of a stannous fluoride solution; and (4) the daily home use of a stannous fluoride dentifrice[11]. In clinical studies[43, 54, 55, 56, 57, 83] conducted in both fluoridated and nonfluoridated communities, use of the three topical therapies in combination has demonstrated significant effectiveness in children and adults. Reductions in dental caries incidence of 75% to 85% have been observed when the studies were conducted in fluoridated communities. Slightly lower percentage reductions were noted when the study sites were nonfluoridated areas. While use of the multiple fluoride therapy will not completely eliminate the development of carious lesions, it would appear to be more effective than

****Gleem II—The Proctor and Gamble Company; Cincinnati, Ohio.*

the use of any single fluoride treatment.

The use of stannous fluoride as the topical component in multiple fluoride therapy does not indicate that the combined use of other agents lacks effectiveness. However, there are no reports of clinical investigations evaluating possible cariostatic effectiveness resulting from the combined use of the sodium monofluorophosphate dentifrice, topical applications of the various acidulated fluoride-phosphate solutions and gels, and/or sodium fluoride topicals. Further research is needed in this area. The results of such investigations might increase the clinician's flexibility in the selection of agents for use in multiple fluoride treatments.

SUMMARY

A review of a number of articles reporting the results of laboratory and clinical studies indicates that there are several approaches open to the clinician in rendering supplemental systemic and posteruptive fluoride treatments to his patients. In all probability, the most effective fluoride therapy is one of a multiple nature. Complicating the problems of choosing the best therapy for patients is the fact that at present there is an almost infinite number of supplemental systemic and topical fluoride preparations commercially available to the dentist. In the case of many of these preparations, the in vitro and clinical data demonstrating their cariostatic effectiveness are sufficient and irrefutable. Concerning other commercially available fluoride products, the lack of sufficient laboratory and/or clinical data precludes recommendation of their use at the present time.

In selecting fluoride agents for treatment of his patients, the dentist should exercise sound professional judgment and base his therapy upon the patient's needs, age, history of water fluoride consumption, and susceptibility to dental caries. He should be aware of the efficacies of the fluoride agents he dispenses. Certainly, in choosing a fluoride preparation, the dentist should place greater emphasis on sound scientific literature, including *Accepted Dental Therapeutics*, than on commercial advertisement.

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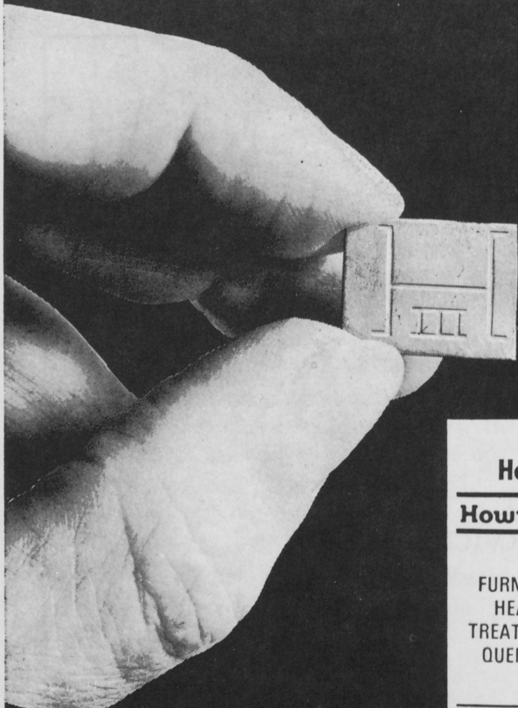

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Comparison of physical properties of Howmedia III Alloy and Type III casting gold

Howmedica III ALLOY			TYPE III GOLD	
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	37,000	PROPORTIONAL LIMIT (PSI)	30,000	
	25	ELONGATION (%)	39	
	150	BRINELL	110	
BENCH COOLED	77,500	ULTIMATE TENSILE STRENGTH (PSI)	87,000	HARDENED (A HARD TYPE III GOLD)
	42,500	PROPORTIONAL LIMIT (PSI)	45,000	
	14	ELONGATION (%)	20	
	160	BRINELL	200	
	7.9	SPECIFIC GRAVITY† (GM/CC)	15.6	
	0.014	THERMAL CONDUCTIVITY†† (CAL. CM/CM². SEC. °C)	0.117	
	4.25	WEAR RESISTANCE††† VITALLIUM® ALLOY (VITALLIUM=1)	5.95	

† Astuenal #4 Gold Used

†† Thermal conductivity was obtained by measuring electrical conductivity and converting to thermal conductivity per the Wiedemann-Franz-Lorenz Law. Gold Sample was Austenal #4.

††† When results were obtained by comparing volume loss of equal size alloy samples of Howmedica III, Austenal #4 and Vitallium®. Numbers indicate relative volume of material lost as compared to Vitallium alloy (Vitallium=1). A standard abrasive paper was used.

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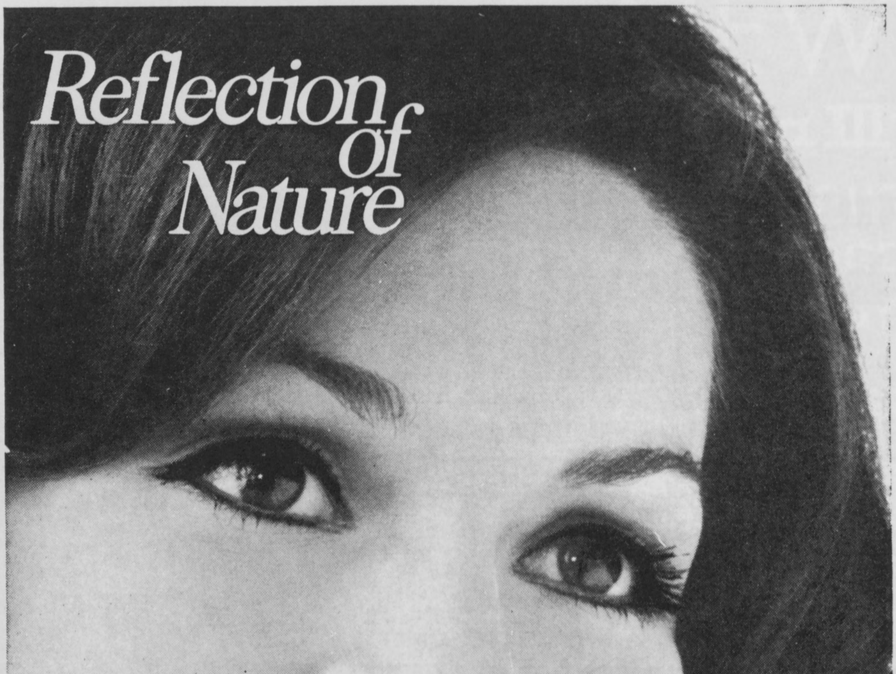

Reflection of Nature

TAKE A 2 MINUTE DENTURE QUIZ

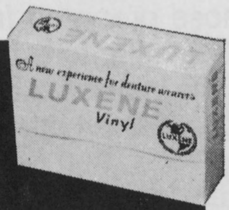
1. Which denture material is most resistant to wear? ☐ Vinyl ☐ Acrylic
2. Which denture material absorbs less moisture, causing less odor? ☐ Vinyl ☐ Acrylic
3. Which denture material is less likely to cause tissue inflammation? ☐ Vinyl ☐ Acrylic
4. Which denture material is dimensionally stable, with virtually no shrinkage? ☐ Vinyl ☐ Acrylic
5. Which material is considered the "premium" denture material and is more resilient, virtually resisting breakage? ☐ Vinyl ☐ Acrylic

Answer:
Laboratory tests show that if you answered Vinyl to every question, you score 100%. But remember only Luxene is the "original" and proven premium vinyl denture material.

Ask for it by name...

LUXENE®

—Original Vinyl Formula Dentures



These laboratories can provide you with

LUXENE®

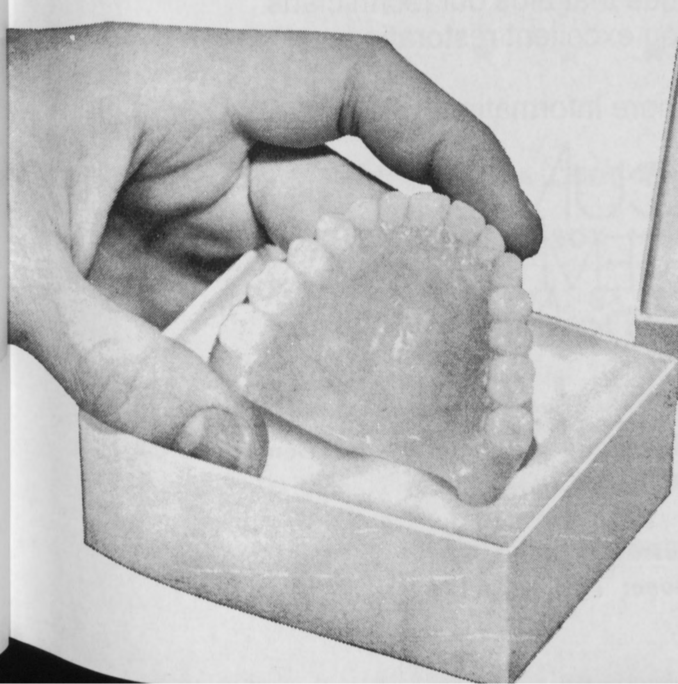
—Original Vinyl Formula Dentures

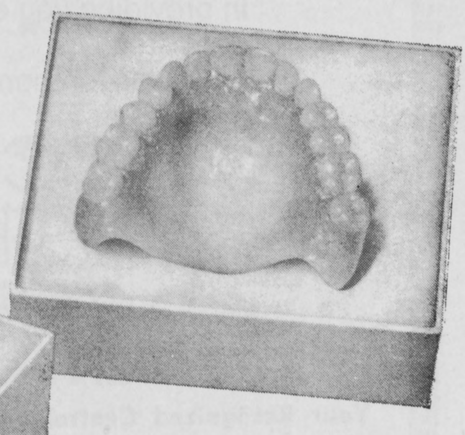
ACME DENTAL LABORATORY
5509 Lakeside Avenue
P.O. Box 9552
Richmond, Va. 23228
804 266-8791

DANVILLE DENTAL LABORATORY
747 Main
P.O. Box 151
Danville, Va. 24541
804 793-2225

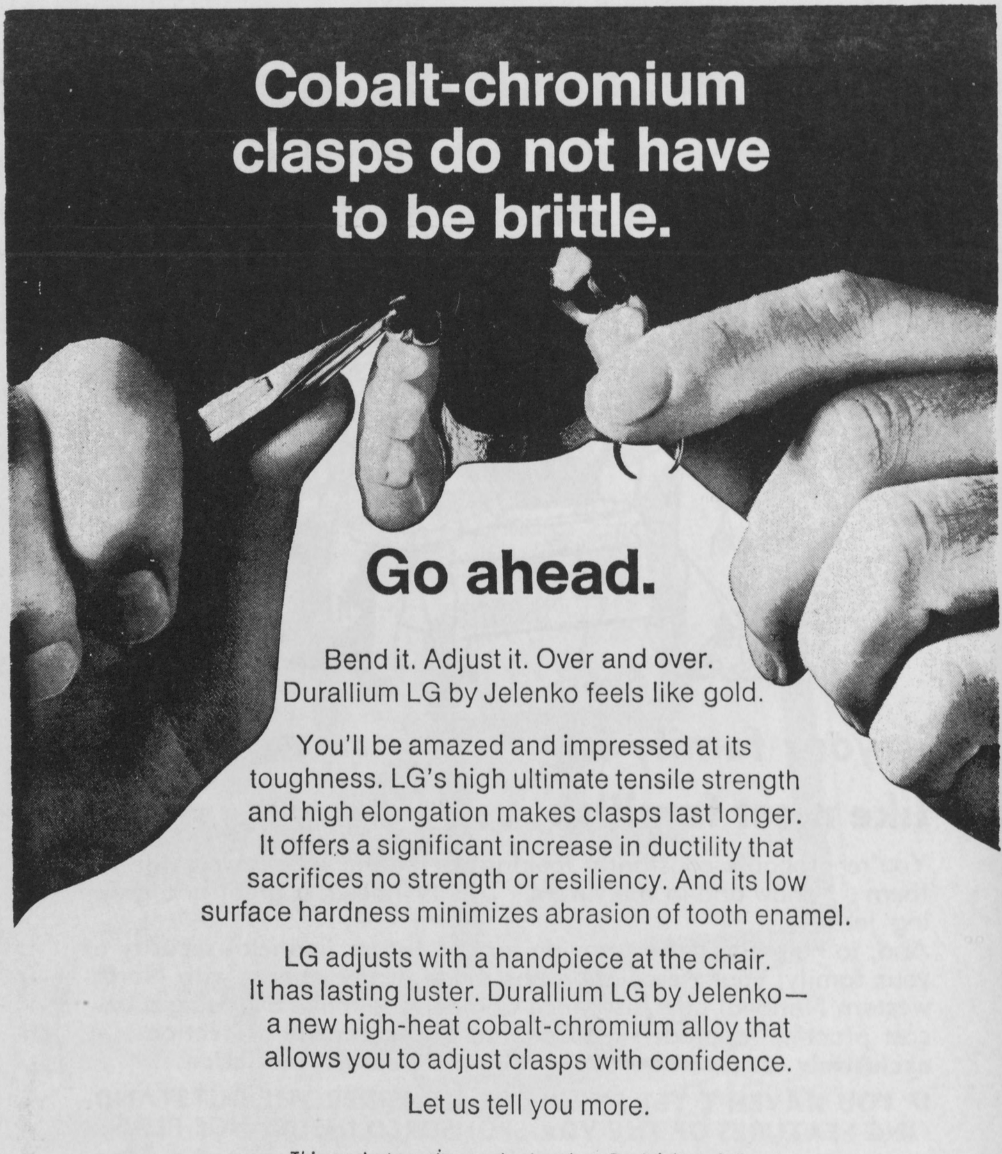
SAUNDERS DENTAL LAB., INC.
a Medenco laboratory
110A W. Church Avenue
P.O. Box 840
Roanoke, Va. 24004
703 345-7319

VIRGINIA DENTAL LABS., INC.
130 W. York Street
Norfolk, Va. 23501
804 622-4614





Howmedica, Inc.
DENTAL DIVISION
5101 South Keeler Avenue Chicago, Illinois 60632


Cobalt-chromium clasps do not have to be brittle.
Go ahead.
Bend it. Adjust it. Over and over. Durallium LG by Jelenko feels like gold.
You'll be amazed and impressed at its toughness. LG's high ultimate tensile strength and high elongation makes clasps last longer. It offers a significant increase in ductility that sacrifices no strength or resiliency. And its low surface hardness minimizes abrasion of tooth enamel.
LG adjusts with a handpiece at the chair. It has lasting luster. Durallium LG by Jelenko— a new high-heat cobalt-chromium alloy that allows you to adjust clasps with confidence.
Let us tell you more.