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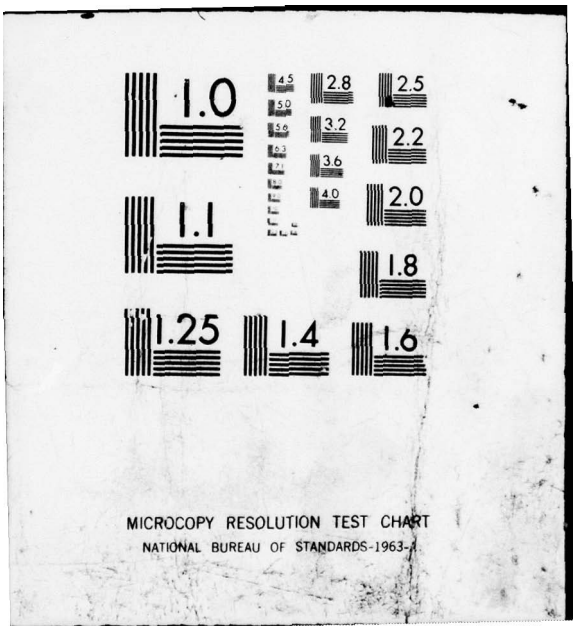
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AEROMEDICAL REVIEW

PORTRAIT OF A NATIONAL DENTAL CONSULTANT

Life Story of a Prevention-Oriented Dentist: An Interview with Miles R. Markley, DDS

Arden G. Christen, Colonel, USAF, DC

October 1978

USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas 78235

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This Review has been reviewed and is approved for publication.

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This is the life story of Dr. Miles R. Markley, DDS, of Denver, Colo., as told in detail to interviewer A. G. Christen. Dr. Markley, a National Consultant in Restorative Dentistry to the USAF Surgeon General (1960-1970), is a noted author, lecturer, teacher, and clinician. He has introduced many practical and prevention-oriented restorative techniques, and has greatly stimulated the teaching and practice of quality operative dentistry throughout the Air Force. This Review traces the development of these ideas, and his involvement with military dentistry from 1948 to the present.

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PREFACE

The author wishes to express gratitude to Ms. Ena Borden Shaw, Medical Editor, USAF School of Aerospace Medicine, Brooks AFB, Texas, for taking a special interest in this project. Many of the imaginative and innovative changes that she has proposed--concerning format, organization, style, and syntax--have been incorporated in the final manuscript. For their important changes in and contributions to the material in this Review, special thanks are expressed to Dr. Markley's sister, Luella Markley Mockett, of Kimball, Neb., and to her daughter, Jane Quinette, of Denver, Colo., both of whom are journalists.

Finally, and most important of all, I am grateful to Dr. and Mrs. Markley for granting me access to their past and present life and activities during the 12 months in which the manuscript was in preparation. They have held back nothing, and have graciously complied with all of my requests, which by now have been legion!

Alistair Cooke, in Six Men (9), has expressed how I feel about the Markleys:

> *"You can meet some people thirty, forty times down the years, and they remain amiable bystanders, like the shore lights of towns that a sailor passes at stated times but never calls at the regular run. Conversely, all considerations of sex aside, you can meet some other people once or twice and they remain permanent influences on your life."*

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Life Story of a Prevention-Oriented Dentist: An Interview With Miles R. Markley, DDS

INTRODUCTION

I first heard Dr. Miles R. Markley (Fig. 1) lecture in early February, 1958, at Lowry Air Force Base, Denver, Colorado. The teachings of this man made an immediate impression upon me, and thereafter greatly influenced my philosophy and practice of dentistry. In the period following our meeting, Dr. Markley became a National Consultant in Restorative Dentistry to the Surgeon General, U.S. Air Force, from 1960 to 1970, having already served in that capacity for the U.S. Army since 1946.

My subsequent assignments at the Air Force Academy (Colorado Springs, Colorado) and at Indiana University (Indianapolis, Indiana) for graduate training in General Dentistry, put me partly out of touch with him. However, during my stint as Training Officer and Chairman of the Department of General Dentistry at Wilford Hall USAF Hospital, Lackland AFB, Texas (1965-1970), I came into a very close working relationship with Dr. Markley. During that period, he visited San Antonio numerous times to teach operative dentistry to our staff, general practice residents, interns, and postgraduate students. I read and reread the articles that he had written over the years (21, 23-31). Interestingly, as a result of a timely recommendation to higher authorities by Dr. Markley, Dr. Sumter S. Arnim [1] became National Consultant in Preventive Dentistry to the Air Force in 1968 (5).

In 1968, on a hot August day, Dr. Markley and I worked together with John E. Devlyn (Colonel, USAF, DC, currently Aerospace Defense Command Dental Surgeon) and Mr. William J. Wengler, from the Television Section, USAF School of Aerospace Medicine, Brooks AFB, San Antonio, to produce a TV video tape on Markley's pin amalgam technique. Even though this video tape was made under extremely adverse conditions (in a crowded, makeshift studio operatory with high room temperatures), the edited tape is still considered a classic

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1/ *EDITOR'S NOTE: Another Aeromedical Review, similar to this one, is currently being prepared by Colonel Christen. The material in the forthcoming publication has been drawn from his in-depth interviews of an eminent dentist.*

and is used in various military and civilian teaching programs around the country. I was impressed by the fact that Dr. Markley brought, at his own expense, his dental assistant--Miss Ruby J. Zoberst--to help us make the tape. [2]

I was able to take Markley's first one-week Operative Dentistry Refresher Course, given for the Air Force at Lowry AFB, in November 1968. I observed how effectively he combined didactic with practical "hands-on" procedures. Even when I was reassigned to Europe (1970-1975), our paths continued to cross. As guests of the Spanish Dental Society, we taught several participating courses together during April 1973, in Barcelona--and again in October 1974, in Madrid. (During those years I was stationed in northern Spain and England.) We can state with some pride that the latter course was the first participating postgraduate course to be taught at the University of Madrid Dental School. It was also the first postgraduate dental course of any type to be given at the new dental school in Barcelona. I vividly recall, one day, just prior to the beginning of the Barcelona course, when we tramped the streets of this crowded city as "tourists." The nearly 30 years between our ages seemingly made little difference. Dr. Markley refused to take taxis and elevators, and we spent the entire day flitting from church to museum to art gallery. All day long his stereoscopic camera was clicking away. I was dog-tired at the end of that day!

During these European experiences I came also to know Miles' talented wife, Winnifred. In Spain, we all spent many nervous moments together in overcoming numerous difficulties, including cultural and language barriers. This capable and supportive woman has obviously played a large part in Dr. Markley's success over the years. In fact, she has traveled with her husband to many of the courses he has given all over the world.

Dr. Markley, who has taught courses in every state in the U.S. and throughout the world, has won scores of awards. In 1975, in Las Vegas, he was a recipient of the Award for Outstanding Achievement in Preventive Dentistry for the American Society for Preventive Dentistry. A singular honor for a general practitioner!

The following interview was taped at Dr. Markley's home in Denver on a rainy Saturday, June 18, 1977. Our conversation

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2/ *Miss Zoberst, an extremely accomplished and personable dental assistant, worked for Dr. Markley for 29½ years. Although she lives in Colby, Kansas, she still returns occasionally to Denver to help sort and mount teaching slides.*

Figure 1. Dr. Miles R. Markley, DDS, of Denver, Colo., in the late 1960's.

was held at the dining-room table, bearing various scrapbooks, awards, photographs, and other memorabilia to jog his memory (Fig. 2). Later that day, when we attended the 7th Annual Scientific Conference of the American Society of Preventive Dentistry in Denver, I observed him taking down notes furiously. He's still learning!

THE FORMATIVE YEARS

CHRISTEN: Miles, our longtime association and friendship has proven to me that you not only preach wholesome living but that you and Winnifred practice it in your home life as well. Please tell me about your formative years and family background, and how these early years have influenced your life.

MARKLEY: I was born at home in Juniata, Nebraska, on November 5, 1903. When I was about six, we moved to the western Nebraska county-seat town of Kimball. As a boy, my parents helped me raise vegetables and fruit, which I peddled to the homes and hotels of our barren frontier town. Everyone in this community was starved for fresh fruit and vegetable products because the country stores made no attempt to carry fresh produce other than potatoes. It was then thought that the arid land would grow nothing but buffalo grass. However, my parents were excellent gardeners. My father had been reared on a farm. My mother, née Mildred Veley, was an orphan and earned her keep with a market-gardening family in Michigan. She never lost that interest. My parents had a full city block, irrigated by a windmill and protected from roaming cattle by a barbed-wire fence. They set out to prove that the land was really fertile. Our surplus garden produce was sold in town, first from a large toy wagon and later from a bicycle basket. I received a citation and a gold medal from the Garden Club, which later became the 4-H Club. Our family also won ribbons for their quality flowers and canned produce at the County Fair. The corn fodder and vegetable tops became food for the family cow, "Bossie," and the horse, "Nellie." Nellie contributed transportation and also plowed the garden; Bossie supplied wholesome Jersey milk, cream, and butter. We made butter and buttermilk in a stoneware churn, such as you may still see in antique stores, and cottage cheese was a wholesome byproduct. (The local milk supply was extremely suspect.) We had chickens for eggs and meat. We seldom had steak. Round steak, at 20 cents a pound, was too expensive for us. However, there were cheaper cuts for stew, pot roast, and soup. Liver was thrown in as a bonus. We didn't have much money, but we lived well. Nellie pulled a rubber-tired surrey--with a fringe on the top, patent-leather fenders, and a dash--which was used Sunday afternoons for pleasure trips. Otherwise, we walked (healthfully, as we now know) to church, to school, to shops, or on an

Figure 2. Miles R. Markley, reminiscing about those who have provided guidance, counsel, and encouragement in his life. Photo taken at the dining-room table in his home (1120 Hudson Street, Denver, Colo.), on June 18, 1977. (Photo by A. G. Christen)

occasional fishing trip to Lodgepole Creek and to the reservoirs being built for a new industry, sugar beets.

Nellie finally became old and stumbled so badly that she was not safe. Eventually the veterinarian led her mercifully away. For my brother, Richard, 10 years younger, the cow's milk was replaced by that from a milch-goat.

As a high-school youth, I developed several interproximal cavities. The reasons are now obvious! I worked evenings and Saturdays as a clerk and delivery boy in a country store, and had free access to the candy counter. My mother used quantities of sugar in making her jams and jellies, and in canning the fruit of which she was so proud. She was also an expert in making homemade candy. A dishpan of popcorn covered with sugar syrup was a Sunday tradition. We bought honey in 60-pound tins, and sugar in 100-pound sacks. My parents believed sincerely that sugar was a sound additive to a wholesome diet, as many people believe today. My father ate sugar on cottage cheese and on fresh tomatoes. Homemade bread was made from white flour that came in useful 48-pound cloth sacks.

CHRISTEN: Your father was also a dentist. What was dental practice like during those early days?

MARKLEY: My father, Dr. Melvin Markley (Fig. 3), was the first resident dentist in Kimball. His older brother had been the town's first resident physician before the turn of the century. My dad's class of 1896 was the first graduating class from Philadelphia Dental College (now Temple University) to be supplied with G. V. Black's newly invented foot engine. [3/] He used this equipment throughout his 50 years of practice. My cavities were prepared with this foot engine, as soon as they could be clinically detected, using silver amalgam and gold foil. No anesthetic, of course!

My father received only 50 cents for extracting a tooth. If he subsequently made the vulcanite dentures in his kerosene-fired vulcanizer, he deleted the extraction charge. Generally his unsophisticated patients wore these dentures for the rest of their lives. He required that his patients do without any teeth for at least 6 months (12 months was preferable) before being fitted for artificial dentures. He met my mother when she came as a patient, before age 21, for

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3/ *Greene Vardiman Black is considered to be the father of modern dentistry. His greatest contributions to the professional literature were his Operative Dentistry and Dental Pathology (2) which went through seven editions. He was born in 1836, and died at his boyhood home (a farm near Jacksonville, Ill.) on August 31, 1915, from pernicious anemia at the age of 79.*

Figure 3. Dr. Melvin Markley, DDS (father of Miles R. Markley), at age 83, three years before his retirement.

a full upper extraction and denture. (Together, we were able to help keep most of her lower teeth for the rest of her life.) My father's office was in our home in those early days so that, between patients, he could garden and attend the livestock. The treatment for caries was either a filling or extraction. There was a suspicion that my illness with typhoid may have been the cause of my cavities, as it well may have been, for my teeth were probably never brushed once during the entire two months I spent in bed. My dad was trained on the east coast, far from the clinical teachings of G. V. Black, who was already lecturing on principles of prevention--including the use of toothbrush and toothpicks. Dad missed Black's principles of "extension for prevention" in cavity preparation. In one way, this was a blessing, for he never learned to overcut or mutilate teeth. His full crowns were beautifully contoured shell crowns, which required minimum cutting of tooth substance, leaving a full thickness of enamel at the margins. There was no shoulder cut into dentinal tubules. (Dentin itself is a good culture media, being half protein and water.) He contoured these crowns himself from 24K gold plate, soldering the joints with a gasoline fueled blow-pipe activated by a foot-pump bellows.

When he announced that he would retire in 1946, at the age of 86, we took our two children (ages 3 and 4) to Nebraska for the experience of having grandpa clean their teeth. Three-year-old Johnny was fascinated by the old foot-engine wheel going around.

Most health factors are in our control, but there is one that is not controllable--our choice of ancestors. In that, I have been most fortunate. My mother died at 75 of causes that the wonder drugs would now control. My father lived, within his knowledge, a well directed and healthful life. He had, with the exceptions I have noted, a purposefully healthful diet. He died at age 96-1/2, with a full set of 32 much restored but vital teeth. He abstained from alcohol and tobacco, and did not drink coffee, bottled soft drinks, or tea. He seldom used any drugs, even aspirin. He slept like a baby. He took things as they came without needless worry. Studying his office records after his death we found that, during one month of the depression, his office grossed less than $100. But he made no fuss about it. Actually no one knew about it. His financial house was in order. During those tough depression years, he spent his extra leisure time reading, writing, gardening, playing the violin, or listening to recorded classical music on a phonograph. His was a life that we could all emulate.

CHRISTEN: What type of a parent was your father? Was he a strict disciplinarian?

MARKLEY: Well, I suppose he was. But he was very nice about it. He was quite engrossed in his practice; and he was a very busy, energetic person. It was a wonderful occasion when he would close his office and take us children fishing. He also taught me to use tools in his workshop. Because his father had been a cabinet-maker, my dad was talented in that field. He was a very kindly, unobtrusive parent.

My mother was also a guiding influence in my life. She was an industrious person, a real "go-getter." Nobody was lazy around her. Both parents were sticklers for moral living, but in a very nice way. We just assumed that this was the way life should be. We were taught to be truthful. My parents gave us, really, all of the advantages. We didn't have much money, but we didn't know it. We had wholesome living in a small town, with both parents as wonderful examples.

CHRISTEN: How many children were there in your family?

MARKLEY: Three. I have one sister, Luella Markley Mockett, two years younger, who is a journalist and the mother of three. We have one brother, Richard Eugene, 10 years younger, who is an ophthalmologist in Portland, Oregon; he has one son, Carl. Not a very prolific family.

THE COLLEGE YEARS

CHRISTEN: How did you decide to go into dentistry? What was dental school like in those days, particularly as related to operative and preventive dentistry?

MARKLEY: As a boy, I had always planned to be an engineer. Upon graduation from our agriculturally oriented high school in western Nebraska, I went to Michigan for a year to live and work for an uncle who made surgical instruments and small appliances. I had what amounted to an apprenticeship as a machinist. Then I went to the University of Nebraska to study engineering for my first college year. At the end of that first year, I saw nervous seniors scrambling around, worrying about where they could go and wondering if they could get a job somewhere. Many of them would end up at places they didn't really want to be, doing things they didn't want to do. I decided I wanted to be more independent than that. I had never really thought of studying dentistry. I had grown up in a dentist's family and, at this point, decided that maybe dentistry did have something to offer.

Since we lived in western Nebraska, we were closer to Denver than to Lincoln (site of the University of Nebraska). Both the University of Denver and the University of Nebraska

had good academic standing. Both dental schools had meager physical plants but good faculties. Both had been old proprietary schools. Soon after the University of Denver took over the school, the Colorado State Legislature passed an act with an appropriate mill levy to build a new dental and medical school in Denver. The University of Denver didn't feel like spending much money on the dental school after the act was passed. The University expected the State to accept and perpetuate the existing school. Unfortunately, the medical school was built first because there was already a dental school. The medical school could always thereafter think of something it wanted more than a new dental school on their campus. The University of Denver carried on with the old facilities. We had no plumbing or compressed air at the ancient chairs. We used foot engines. Many of the clinical faculty were successful practicing dentists who were sacrificially rendering part-time service at the Dental School. After the ADA Council of Dental Education rated the School down because of the inadequate physical facilities, the University of Denver announced that it would close the School in 1932 (expecting that the University of Colorado would continue it). But the Depression came on, and more than 40 years went by before the State grudgingly accepted the responsibility.

Even so, we had a good background in dental education. There was one full-time man, Dr. Joseph G. Ewers, who was better qualified in restorative work and more fastidious than the others. He helped me a lot. He was a top gold-foil operator, and an absolute stickler for excellence. We had the right to choose the instructor we wanted to check our cavity preparations and procedures during the various steps, and I made it a point to have him check mine. Those who were satisfied with a lesser result would choose one of the inexperienced men, perhaps one who had graduated the year before. Dr. Ewers meant a great deal to me, both while I was in school and five years later when I moved back to Denver. Unfortunately, he died during the late 1930's and the profession lost a valuable member. We also had a splendid prosthodontist, Merrill G. Swenson, who later wrote practical texts on full and partial dentures.

CHRISTEN: Was a concept of preventive dentistry taught to you during your dental school years?

MARKLEY: No. There was really no training in preventive dentistry. I was once told that I wasn't brushing my teeth well enough. We did have a Department of Periodontics, such as it was. Periodontal treatment consisted of scaling and root planing, but really very little was said about preventive care. Recognition of plaque as the culprit came years later.

However, articles concerned with prevention were starting to appear in the dental literature. In the 1920's, May Mellanby,[4] a dietician for a group of remarkably caries-free children, was writing in dental journals that a wholesome diet alone would prevent caries (34). Her institutionalized tubercular children were on a closely regimented and controlled diet; but, on the so-called "good" diet that my sister and I were fed, we were developing multiple proximal and pit and fissure caries. What could be wrong? It developed that May Mellanby's children, on a strictly sugar-free diet, had fewer cavities. About the same time, Boyd and Drain (3), working with diabetic children at the University of Iowa, noted that caries became arrested when these children were taken off sugar concentrates. Another observing Colorado dentist, Dr. Frederick S. McKay, and G. V. Black (33), described mottled enamel in 1916 and stated that people with the disfiguring condition had fewer dental caries than those having normal enamel. By 1931, two separate investigators showed that excess water-borne fluorides caused the fluorosis; of course, we now know that systemic fluorides in trace amounts can appreciably reduce dental caries.

CHRISTEN: How did the Dental School in Denver compare with some of the eastern schools at that time:

MARKLEY: Well, if you judged by the quality of graduates, I think it rated well. If you considered just the physical plant, it was the top of nothing. Denver was noted for good instruction in clinical dentistry.

CHRISTEN: What role did the Dental Fraternity (Delta Sigma Delta) serve in the Dental School?

MARKLEY: We had some nice parties and social activities, which were important to me because I was a country boy. At almost every meeting we would have some scientific presentation by older members of the fraternity. These programs were really my first introduction to continuing education and its possibilities.

CHRISTEN: In reviewing some of your personal papers I noted that, when you received your DDS from Denver University in June 1927, you were awarded a diamond-studded Delta Sigma Delta pin for graduating with the highest honors.

4/ *In 1928, Mellanby wrote (34): "The resistance of teeth to caries and attrition can be influenced by diet independently of their original structure."*

CHRISTEN: Where did you practice after leaving Dental School?

MARKLEY: I practiced with my father in Kimball, Nebraska, for five-and-a-half years. During that time, I learned much from him about ethical dental practice. The patient's welfare was his prime consideration. In addition, I learned the value of keeping good records. All through my life, by example, he taught me to be meticulous.

Of course, we did not see eye-to-eye in many things. There was a generation gap. I now know that he was often ahead of me. He was patient, while I was impatient for results. It was always amazing to me that his patients had so much confidence in him. Many thought I was a young upstart, which I now know that I was. It was valuable training.

Incidentally, I had been in practice just two years when my college sweetheart, Winnifred Lute, and I were married. After graduation from the University of Denver and before we were married, she taught Spanish and Latin at the High School in Sidney, Nebraska, 40 miles east of Kimball.

As a lad, I had been fortunate enough to join the Boy Scouts, when this organization was still getting a start in the United States. As I began practice in Kimball, it seemed only right that I assume the leadership of a Lion's Club Troop. With that five years of experience behind me, I later accepted leadership of a Kiwanis Club Troop in a slum area of Denver. The Troop became a real "going" concern. We had many week-end campouts on the Kiwanis mountain reservation. After five years that Troop was passed on to another Kiwanian when I assumed a position with the Denver Council of Boy Scouts. (I'm still a Kiwanian after 35 years of active membership.)

CHRISTEN: Why did you move to Denver in 1932?

MARKLEY: A 10-year drought resulted in the "dustbowl years." It, and the Depression of the 1930's, caused more than half of the population to move away from the Kimball area. With 20-cent-a-bushel wheat, those who remained were reduced to emergency dental care only, which was paid with chickens, eggs, butter, and potatoes (if it was paid at all). I resolved to find a place where I could practice preventive dentistry for a clientele who would appreciate and afford conservative care. So Winnifred and I moved to Denver at the bottom of the Depression.

Fortunately, Denver's original water supply had optimum fluoride which was maintained to that standard as additional supplies were developed. Therefore, Denver already had an

advantage as a good place to preserve natural teeth. The leisure of the Depression years allowed time for continued study and for perfecting restorative techniques. I made hundreds of castings using various methods, initially with homemade steel dies and later with Bureau of Standards dies. I learned that there was no such thing as an accurate casting, even by the most exacting technique. In fact, I am still learning to compensate in the casting process.

Visits to George M. Hollenback and to James T. Sweeney, in their offices in California, began to clear up some of our problems with amalgam. I still visit the Bureau of Standards Dental Research Department whenever we are in Washington, D.C. Dr. I. C. Schoonover (now long since retired) and Dr. George C. Paffenbarger helped me immensely. Soon various dental groups began to invite me to present lectures and demonstrations. These courses were eventually to be held over much of the world.

My lectures have usually been on technical and restorative subjects; but, as an introduction, I have always stressed the importance of prevention and the conservation of tooth structure. The theme, "Saving Teeth for a Lifetime of Service," has been my philosophy--my umbrella for care. This philosophy is being taught in more and more dental schools today. For example, the Medical College of Georgia was opened, using these techniques, under David E. Beaudreau. Years before, I had met Dave while he was a graduate student at the University of Pennsylvania where I was presenting a course. I have returned to Georgia each year to reinforce this teaching.

In 1974, following a three-day course which I taught at the University of Pennsylvania, the Director of Restorative Dentistry, Dr. Daniel Isaacson, and his secretary were sent to Denver to copy some 1,600 of my slides. The reprints, manuscripts, and the information on preventive dentistry were edited into teaching material for their students. Three days of lecture were given again at the University of Pennsylvania in 1975. More recently, the University has been decentralizing its continuing education courses through the northeastern United States. Dentists prefer travel to less congested areas than Philadelphia to attend short courses.

CHRISTEN: How did the Denver area receive the ideas of G. V. Black on "extension for prevention" and on cavity preparations?

MARKLEY: They were gospel! We didn't know anything else. We used his Volumes 1 and 2 of Operative Dentistry as our "Bible," so to speak (2). Of course, we realize now that

Black grew up in an era when few people had a toothbrush. He was a pioneer in advocating the extension of cavities out to what he considered an immune, self-cleansing area in an uncared-for mouth. I am sure that if he were now alive he would have modified his teaching as we have done. We still don't violate any of G. V. Black's basic rules, but have simply brought them up to date.

CHRISTEN: How well have Black's teachings held up over the years?

MARKLEY: Very well. They are still being taught in many dental schools. Of course, in his day, people didn't live as long as they do now. He didn't realize that he was creating weak teeth by what we consider to be overextension We now realize that the less the tooth structure is destroyed, the stronger the tooth will be. One of my more recent lectures is concerned with solving the cracked tooth problem. We are seeing more and more cracked teeth as our patients grow older. Few of these patients are under age 45. In Black's day, older people more or less expected to lose all of their teeth eventually. Today, it's not necessary. With early diagnosis, conservative restoration and prevention, people don't have to lose their teeth.

Even though patients come in with badly broken-down teeth, we now have ways of building up and restoring a solid root to useful service. Our concepts have changed. In my father's day, practically no one came unless he had a toothache. My father started with emergency care, but did have a preventive vision because he would say: "Now look, you don't need to have this happen again, let's check these teeth more frequently." He did a very good job of taking care of his patients and preserving teeth, although he didn't understand as much as we do today about the causes of dental disease.

CHRISTEN: What influenced your decision to modify the G. V. Black type of cavity preparation?

MARKLEY: My first five years of practice really opened my eyes. I began to see my failures come back. Time and time again the isthmus of the amalgam would fracture and allow the filling to come loose or to drop out. I didn't know what was wrong. I was simply following what I had been taught. In 1931, Finn J. Bronner (4), a Professor at New York University, published an article modestly suggesting that G. V. Black's principle of the Class IV preparation be applied to a Class II cavity preparation. In this modification, the occlusal was constricted and the proximal extended to remove any caries or decalcification. Teeth were prepared to areas where the dentist could finish them and the patient could

care for them; and, instead of depending upon the occlusal step to retain the restoration, proximal locks were the principal means of retention. This technique rang a warning bell in my mind. I started to prepare a more conservative cavity with proximal locks, and almost immediately my failures diminished. So I went on from there, gaining experience. Eventually the occlusal became constricted even more. Bronner's occlusal had parallel walls. Although margins were in areas of lesser stress (4), his margins were still thin; and so we evolved an occlusal with walls more or less perpendicular to the surface, e.g., parallel to the enamel rods. This technique gave the combination of strong enamel walls and strong amalgam margins. Proximal and gingival margins were also made at right angles to the surface of the tooth. My engineering training taught me that sharp internal angles weakened teeth. At that time, we didn't have instruments to prepare that kind of a conservative cavity. Tradition was very strong, and these ideas represented heresy, so I didn't talk about them very much! But we went on gaining experience, and these ideas were tested and validated by the study clubs I directed.

It wasn't until 20 years later, in 1951, that I had enough courage to publish these concepts (23). The article was given first position in an issue of the ADA Journal. My article suggested a constricted occlusal, with the occlusal walls perpendicular to the surface and the proximals extended only as far as necessary for access. The proximal was held by proximal locks in the dentin that extended well up into the enamel but did not show on the occlusal surface. In this article, examples and illustrations showed that many teeth needed no occlusal step at all, and illustrated that this type of preparation would save tooth structure and strength. At the same time, I described anatomical matrices which made it possible to build an anatomical contour into amalgam, with results fully as good as could be achieved with cast gold restorations. Amalgam proximals condensed against this anatomical matrix needed no interproximal carving, and therefore presented a smooth surface without subsequent polishing. This method saved more than enough time to compensate making the rigid anatomical matrix.

The matrix was evolved from G. V. Black's original concept. George M. Hollenback, in 1932, suggested supporting it with modeling compound. Jim Sweeney taught an interproximal wedge, but his wedge compromised the interproximal contour. Next, we evolved a wedge that would hold the matrix to the tooth at a place not interfering with its contour. This technique allowed final contouring from within with a warm instrument, the S. S. White FP 2 A. This

instrument had been designed for placing silicate restorations. Pedodontist Walter McBride, of Detroit, added punched holes to hold the dentotape. Black's matrix had ears bent at the gingival to hold the tape, made possible because his matrix was thick and hard. McBride's idea allowed us to persuade the Crescent Mfg. Co. (Lyons, Illinois), to develop a thin (0.0015") three-fourths hard (therefore burnishable) matrix material. We evolved 2-, 3-, and 4-hole matrices to which was added a special class V matrix.

I had learned to make a fairly good cast restoration at Denver University Dental School; and I believed, well into the 1940's, that the gold inlay was by far the best restoration. I sincerely thought that amalgam was a compromise restoration. But that belief didn't keep us from improving amalgam. I now know that modern amalgam is the superior restorative. Several cemented restorations, that were made to the best of my ability for my wife, were removed after 33 years of service because the teeth had worn and now needed splinting onlays instead of inlays. When those inlays were sectioned and photographed for study, I could see that marked cement deterioration from percolation would have terminated the usefulness of the restorations within her lifetime. Actually, that amount of percolation might already have brought recurrent caries, had our family not restricted sugar concentrates. So in more recent years we have come to believe that, for younger people, a conservative amalgam filling is the best restorative that we have to offer--surpassing even compacted gold for many situations. Amalgam is our only self-sealing restorative.

CHRISTEN: Would you describe how the instrumentation evolved from the larger cutting instruments of Black's time to the smaller ones of the present day?

MARKLEY: When we visualized that we didn't need such wide cavities, and that we were actually weakening teeth with traditional cutting procedures, we had to start using smaller burs and hand instruments. This technique created more work because we had only slow speed, and we were limited to carbon-steel cutting edges. There is an engineering principle that smaller rotary instruments require greater speed. When tungsten carbide burs came on the market, they cut much better; but it wasn't until the advent of higher speed engines that we made real progress.

In engineering, I'd learned that sharp internal line angles in any structure would create a fracture zone, so I visualized that we should prepare the interior of cavities with rounded corners. We had no instruments to make them. I tried in vain in the early 1940's to interest some instrument maker in producing an inverted cone bur with

rounded angles, but no one was receptive. World War II came, to further interfere with domestic supplies, and I couldn't get anything of that type made. The war brought a serious shortage of burs, and we had to resort to having our old burs sharpened. Providentially, those burs came back with rounded corners! Hence, from 1943 until 1957, when we were able to have an amalgam pear-shaped bur made and marketed, we used resharpened burs and prepared cavities with rounded internal line angles. From that time on, we have seen fewer fractured teeth from our restorations.

In 1956, I was able to interest George Beavers (of the Beaver's Bur Company, Morrisburg, Ontario, Canada) in the project. He told us that if we would give him a mock-up of the shape and size of bur that we wanted, he would then duplicate the bur in tungsten carbide. So in 1957, the first pear-shaped bur, "the 330," was born. We wanted a still smaller bur, but the tungsten carbide of those days wasn't enough. A few years later George Beavers began making his own tungsten carbide because he was unhappy with the metal he could buy. He then produced "the 329," which was an exact copy of the 330 in length, but narrower. Now we were able to prepare conservative cavities in very small teeth.

Conventional condenser points would not fit the narrow cavities. So the HuFriedy Manufacturing Company (Chicago, Ill.) was invited to make a series of six double-ended condensers with their large easy-to-grasp handles. They are lightweight, so as not to break when dropped. These supplement conventional condensers.

The tradition toward larger cavity preparations, however, is still strong. As recently as 1973, David B. Mahler, who is a splendid researcher, and Dean Louis G. Terkla (38)--both at the University of Oregon--published an article in the Journal of Prosthetic Dentistry, proving to their satisfaction that a G. V. Black preparation with an occlusal step and no proximal locks produced the strongest amalgam restoration they could make. For me, this didn't ring true to my practical clinical experience. It remained for a Professor of Restorative Dentistry at the Medical College of Virginia, William D. Crockett (11), to prove in 1975 that an occlusal step was unnecessary, and that an amalgam cavity with proximal locks was superior to one depending on an occlusal step. In his research, he made the same preparation that Terkla and Mahler and G. V. Black had used. He found (as they had) that Black's preparation resisted vertical stress very well. But Bronner (4) had shown, in his illustrations of 1931, that proximal amalgams don't fail from vertical occlusal forces. The isthmus fractures from lateral stresses. After the

fracture, the restoration rotates out of the tooth enough to allow leakage and caries. Often the filling comes out completely. Crockett reported that, against lateral stress, proximal locks would give 10 times more retention than would an occlusal step. If an occlusal step is added, only 20 percent more retention is gained. Adding the occlusal step weakens the tooth more than the modest increased retention justifies. We now have clinical and laboratory proof that Black's preparation is obsolete for amalgam.

The inlay still must have an occlusal step, and that's one of the big disadvantages of the intracoronal cast restoration. It weakens the tooth, thus predisposing to fracture. For amalgam, however, there need be no occlusal step if there is no occlusal defect or caries. If there is caries, the preparation can usually be kept very small, opened to the size of a ¼ bur in a turbine, then completed with a #329 pear-shaped bur at slow speed. This is our present teaching.

CHRISTEN: When you proposed your modifications for the conservative cavity preparation, what type of reception did you get in the profession?

MARKLEY: It didn't make a very big dent. Some of those persons who heard my lectures would adopt it, but my modifications weren't given wholesale acceptance. Most schools continued to teach orthodox G. V. Black, and many of them still do today; but we have all the evidence needed now for the conservative preparation. On the other hand, some schools have enthusiastically endorsed the technique. Dr. David E. Beaudreau, then a graduate student at the University of Pennsylvania, took it with him to the new Medical College of Georgia in Augusta. He recently became Dean of Georgetown University, Washington, D.C. I hope that he can also carry that concept there.

George Brass, at the University of Manitoba, was among the first to adopt the conservative preparation. Cosmo Castaldi at the University of Indiana, who was head of pedodontics, started to teach the concept there. However, conflict arose with another faculty member, so he left for Edmonton, Canada. and carried the concept there and later to the University of Manitoba.

EARLY INVOLVEMENT WITH MILITARY DENTISTRY

CHRISTEN: Would you discuss your longtime involvement with military dentistry?

MARKLEY: In 1946, I became a consultant to the U.S. Army at the invitation of Colonel Oscar P. Snyder (Fig. 4), who

Figure 4. Major General Oscar P. Snyder (Chief, U.S. Army Dental Corps, Apr. 1954 - Nov. 1956).

eventually became a Major General and head of the U.S. Army Dental Corps. [5] He was instrumental in developing the dental internship program, because he realized how damaging the conventional armed forces operative dentistry had been during World War II. During the war years, many teeth were sacrificed needlessly. He set up an intern teaching faculty in Denver at Fitzsimons Army Hospital where he was the Dental Surgeon. He visualized that Armed Forces dentistry should really be the best dentistry in the world. With that vision, he brought together some rather important dental educators, including: George R. Warner, known worldwide in radiology; and Wilton W. Cogswell, Sr., an oral surgeon who was noted for being kind to oral tissues. In 1932, Cogswell (7) had published a book which became my Bible in minor oral surgery. Also included were: Balint J. Orban, a periodontist and noted researcher; and William D. McCarthy, who had a great deal of experience during World War II in maxillo-facial surgery and rehabilitation. Hobart H. Proctor (a fine prosthodontist) and I were added to cover the restorative and crown and bridge areas of instruction. Promising young dental officers in the Army and Air Force were competitively chosen to go to one of the teaching hospitals for the one-year rotating internship program. These men were required to pay back an additional one-year commitment for the education they received. We had the cream of the crop in this internship, with a new class each year at Fitzsimons. I spent every Tuesday afternoon there. At the same time, I lectured frequently at Bethesda Naval Hospital, Washington, D.C., to selected Navy dental officers receiving similar training.

It has been interesting to watch the careers of these dental interns as they matured. Over the years, many of these fine young men have made their mark, both in the military and in civilian life. They are, without exception, grateful for the training they have received. All of these interns

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5/ *Major General Oscar P. Snyder was born in Millersburg, Ohio, Jan. 6, 1895. After graduating from Ohio State University with a DDS in 1916, he was appointed a Dental Surgeon with the rank of First Lieutenant in the Regular Army, Oct. 24, 1916. For the next 40 years of active duty, he served in nearly 25 different assignments all over the world.*

In World War I (1918-1919), he sailed for France with the American Expeditionary Forces, and took part in the battles of the Marne, Oise-Aisne and Meuse Argonne. After duty in the Philippine Islands (1924-1927) he was assigned to the Dental Service at Walter Reed General Hospital, Washington, D.C. During this four-year period (1927-1931), he was a member of the Staff and Faculty of the Army Dental School. He also served as a member of the Cooperative Group, American Dental Association, Dental Research Committee, to investigate and report on properties of dental materials. During World War II, he served for 34 months in Melbourne, Australia, as Chief Dental Surgeon for the Southwest Pacific Theater. From July 1945 to April 1948, he was Chief of Dental Service, Fitzsimons General Hospital, Denver, Colo. He became Brigadier General, U.S. Army Dental Corps, April 27, 1948; and, in April 1954, was nominated by President Eisenhower and confirmed by the Senate as Chief of the U.S. Army Dental Corps, with a rank of Major General, a post he held until his retirement from the U.S. Army on Nov. 30, 1956. In Jan. 1957, he was appointed to the faculty of his Alma Mater, Ohio State University, College of Dentistry, Columbus, Ohio (14).

were taught the conservative amalgam preparation and learned to appreciate the value of amalgam. When the intern program was discontinued at Fitzsimons, I was sent to El Paso, Texas, to teach for several more years. In 1955, General Snyder invited Colonel Joe Bernier and me to go on a tour of Europe to lecture to most of the U.S. Army installations there. He always encouraged me. He said: "Miles, you can do it." I didn't think I could. Well, he just kept on inspiring me to do much more than I thought I could. We still remain good friends and correspond rather frequently. After his retirement in late 1956, General Snyder went back to Ohio State and taught there for a number of years. Now he is retired for a second time, and lives in Columbus, Ohio. He is a wonderful person and a great inspiration to the entire dental profession.

In 1960, I was made National Consultant to the U.S. Air Force in Restorative Dentistry. This meant that I was supposed to consult with each of the eight teaching Air Force hospitals every year. (I didn't always make it!) Every other year I was asked to make a foreign trip covering the Alaskan, Hawaiian, and overseas bases. [6] During the next 10

6/ *The following reflections were written by Lt.Col.William R. Forrest, Chief of Endodontics, Malcolm Grow USAF Medical Center, Bolling AFB, Wash., D.C. He recalls the significant impact that Dr. Markley had on him while he was a young Air Force Captain stationed at Eielson AFB, Alaska: "I first heard of Dr. Markley in the winter of 1963 from our supply sergeant. He was bemoaning the difficulty of procuring "special instruments" for the forthcoming visit of a National Consultant who would teach a short course in operative dentistry to three of our nearly dozen dental officers. The Alaskan winter had been especially severe and clinic morale was suffering from a bad case of cabin fever. I had not been chosen as one of the three course participants and my disappointment was apparent. Fortunately, Dr. Markley intervened successfully on my behalf, requesting that I be included as a fourth student. During the course, the logistics of including an additional student required considerably more work for Dr. Markley. He literally ran between operatories from one end of the old T-wing clinic to the other in order to help me. His enthusiasm was contagious, as he worked tirelessly. The course began with an introductory lecture on nutritional control of caries. But only a selected few from the clinic reported for the presentation. Dr. Markley insisted that his comments would be of great value to all clinic personnel, and he had traveled thousands of miles so that all of the clinic personnel could hear it. Since the disinterested Base Dental Surgeon was nowhere to be found, the assistant OIC, also a young Captain, complied with Dr. Markley's request. When the OIC, a senior dental officer who was a "production man" finally arrived at mid-morning, he was quite dismayed to find that the patients had all been rescheduled and the entire staff was listening to the formal lecture. During the remainder of the week, we were totally absorbed in what Dr. Markley had to say. All concept of time was lost! This was where I first learned of and began to practice indirect pulp capping. On Saturday, Dr. Markley requested that a "Gooney Bird" be provided to take the dental officers to visit a radar site beyond the Arctic Circle. The Officer of the Day and the Officer in Charge remained behind. The only means of transportation to Ft. Yukon in winter was by plane. At Ft. Yukon, Dr. Markley participated in a softball game on snowshoes. I was assigned the duty of taking our guest to Fairbanks International Airport for his departure. I realized that he viewed life as an opportunity to act with all the perfection he could to be of service to others. During the following weeks, I succumbed to the familiar tiresome arguments against the use of the rubber dam, only in part due to procurement difficulties. (I never got up the courage to use a condom on a VIP's wife as a substitute dam. Dr. Markley had assured us--with tongue in cheek--that such an approach would hasten the action of procurement.) Following his departure, we were forbidden to even mention his name. Later in 1968, as a newly promoted Major, I attended the first Markley Operative Dentistry Course to be given at Lowry AFB, Colo. It was here that I "got religion" and the dam became a genuine requirement for my day-to-day practice. One of the highlights of the course was dinner at the Markley home where I observed that Dr. Markley's nutritional practice harmonized with his doctrine. The Markley name is invoked with endearment each time my wife bakes stone-ground whole wheat bread after the recipe of Mrs. Markley." (16)*

years, many productive, interesting courses were given in these stateside teaching hospitals and also for armed forces dentists abroad. The Air Force always invited the sister services to attend, and many of them did so. The other National Consultants were all specialists in their respective fields. The fact that there was no specialty for either general or restorative dentistry at that time made us work for the recognition of general dentistry, which came during that decade. Meanwhile I was inspired to study for and pass the exacting examinations of the American Board of Prosthodontics. Earning a diploma in their division of fixed prosthodontics made me feel better qualified for the responsibility. [7] I stayed on as National Consultant until 1970, when I became 65.

The Air Force didn't ask me to retire--in fact, I was urged not to. But I explained: "You retire all of your officers by that age, and it's only fair that I do the same." Later, I was made National Consultant Emeritus, so I could continue to teach. Instead of having to chase over the country and world, they decided to bring the students to me. Brigadier General Lee M. Lightner (Fig. 5), the Air Force Dental Chief, [8] was primarily responsible for establishing

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[7] *Dr. Markley was certified a Diplomate, American Board of Prosthodontics, after passing a clinical examination held at the University of Texas Dental Branch, Houston, Texas, June 22-26, 1964.*

[8] *Lee M. Lightner, was born May 28, 1915, in Guymon, Okla. A 1938 graduate of Kansas City Western Dental College, he entered the U.S. Army Dental Corps at March Field, Calif., in Nov. 1939. During two separate tours in Colorado he became familiar with Dr. Markley's qualifications in operative dentistry. Colonel Lightner was at Lowry AFB, Denver (1956-58), and was the first Staff Dental Officer assigned to the USAF Academy, Colorado Springs (1958-61). He became Assistant Surgeon General for Dental Services in Feb. 1966, and retired in 1970 as a Major General. He is currently living in Kerrville, Texas, with his wife Helen. (For a complete bibliography, see Medical Service Digest (USAF) 18:38, Mar. 1967).*

Concerning the Markley Course, General Lightner recalls (22): "My staff and I were concerned that the recognized specialities of dentistry were receiving most of the attention and schooling yet the general dentist was, and is, the backbone of the profession and carries the brunt of the workload. We were determined to put Dr. Markley's presentation before as many Air Force dental officers as possible. However, we couldn't get the money to conduct the first course because it had not been programmed for during the previous year. We had enough money to pay the Consultants but no TDY or Per Diem money for class participants. Lowry AFB and their dental personnel made the facilities available and did the spade work for planning the course. Dr. Markley enthusiastically agreed to take the time off from his busy practice to teach the course. So the first few courses were conducted for the USAF Dental Officers who attended at no expense to the government. I understand it is still a popular and sought-after course."

The Markley Operative Dentistry Refresher Course, 50209826, is planned to be held at Lowry AFB through 1980. It is fully described in Air Force Manual 50-5, page 3-105, dated 1 June 1977.

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TH DEVELOPMENT OF PIN-RETA AMALGAMS

CHRISTEN: Wo you discuss how y developed pin amalgams? What is your c ent thinking con ning their value?

MARKLEY: I was ta ht to use to retain cast gold restorations in denta chool. had some very good instruction in crown a bridge I remember a football star, who later became an A der st, who had a Class IV inlay that got knocked out i lm every game he played. They brought him to me, and e a pinlay. It was cast to threaded iridio-platinum s. I saw him many years later when he was in the Armed ices (where he spent his whole career), and he still inlay.

Pins are not new n 1928 replaced a fixed bridge made in 1903 by Wi am H. She r, of Omaha, who later became a prominent surgeon. had a pin retainer on a lower cuspid to supporting one nd of a fixed bridge. These were sm platinum pins ov which he must have placed a bac g of pure gold, to b uilt up with solder. Although th bridge was made five y s <u>before</u> the casting process wa eveloped, that pin retai did not fail. A hole had n through a shell crown re ner on the other abutmen llowing caries to consume th abutment tooth.

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Figure 5. Major General Lee M. Lightner (Assistant Surgeon General for Dental Services, United States Air Force, 1966-1970).

an annual operative dentistry course at Lowry AFB, Denver, whereby a class of 12 to 15 "key" career dental officers in the Air Force are chosen to take a one-week course. Colonel William B. Clifford, Dental Surgeon at Lowry AFB, first implemented the course in November 1968. Last year (in 1976) it was televised and taped in its entirety. In this course, we spend one-and-a-half days in lectures, and a day in operating on quadrants of extracted, mounted teeth which the class members bring with them; finally, we go to the infirmary and operate on live patients. After finishing their course, the students are charged to go back to their respective Air Force Bases and share the training that they have received.

THE DEVELOPMENT OF PIN-RETAINED AMALGAMS

CHRISTEN: Would you discuss how you developed pin amalgams? What is your current thinking concerning their value?

MARKLEY: I was taught to use pins to retain cast gold restorations in dental school. We had some very good instruction in crown and bridge. I remember a football star, who later became an Army dentist, who had a Class IV inlay that got knocked out in almost every game he played. They brought him to me, and I made a pinlay. It was cast to threaded iridio-platinum pins. I saw him many years later when he was in the Armed Services (where he spent his whole career), and he still had that inlay.

Pins are not new. In 1928, I replaced a fixed bridge made in 1903 by William H. Sherrer, of Omaha, who later became a prominent oral surgeon. It had a pin retainer on a lower cuspid tooth supporting one end of a fixed bridge. These were smooth platinum pins over which he must have placed a backing of pure gold, to be built up with solder. Although this bridge was made five years before the casting process was developed, that pin retainer did not fail. A hole had worn through a shell crown retainer on the other abutment, allowing caries to consume that abutment tooth.

I didn't have the concept of using pins in amalgam until the late 1930's. Then it seemed only logical to use an occasional pin to help support an amalgam restoration which otherwise lacked sufficient retention. I started using one pin, then two pins and, finally, a number of pins. They held these restorations superbly. We found that pin retention saved tooth structure conventionally cut away for retentive locks. At that time I used the same iridio-platinum threaded pins, 25-thousandths of an inch in diameter, that were used in castings. We drilled the holes with a 27-thousandths-inch spiral drill which was available from

CHRISTEN: The pin amalgam technique has evolved into several variations, including driven and screw type pins. In your opinion, what is their indication for use at the present time?

MARKLEY: Manufacturers tried to patent the cemented pin but found that it had been used too long, so they devised two other techniques that they could patent. One is the driven pin, that is forced into an undersized hole; and the other (the "screw type") is screwed into an undersized hole. All pins take lateral stress the same way. For a vertical pull, however, Donald A. Welk and Walter E. Dilts (40) proved (at the University of Kentucky) that the driven pin would hold one-third more on a direct pull than would the cemented type of pin. A screwed-in pin, of the same length, will hold 3½ times as much as a cemented pin against a vertical pull. Most dentists who use the screwed-in pins make the hole too shallow, grasping but a small amount of tooth structure. These patented forced (screwed-in, or driven) pins have been highly promoted. They have been foisted upon the profession and the dental schools by commercial interests, so they are widely used at the present time. It has been definitely proven by research that cemented pins set up no stress at all until the tooth is in function--whereas of teeth that are restored using forced pins, about every third tooth develops stress "checks" (8). Researchers who study pin stress use young sound teeth for their experiments. In practice, most of the patients who receive pin-retained restorations are older people. As individuals age, their teeth become more brittle. Many older teeth are sclerosed and some become nonvital.

Although I have the two forced types of pins in my office and use them occasionally, I'm afraid to use them routinely. For one thing, it is hazardous if not impossible to place forced pins deeply enough to get an adequate grasp on what remains of the tooth. Secondly, we must realize that a checked or crazed tooth is a potentially split tooth. Cracked teeth have become a serious problem in retaining teeth for older people. Our ideal is to retain teeth for a lifetime of service. There are a few indications where the forced pin types can be used for younger people who have had an accidental fracture in teeth resiliant enough to tolerate (hopefully) a forced pin. I remember one instance, in a younger patient, where a cuspid had been fractured in an accident. I wanted to condense gold foil around the pins. I was fearful that I might loosen cemented pins, so we used a driven type of pin. A legitimate place for a screwed-in type of pin is to repair porcelain fused to metal restorations and retainers. It's safe to drill through the metal, screw in a very short Whaledent type of pin, and then build a composite (compacted gold or amalgam) repair over these pins.

Europe. We began to use many feet of this wire. But I wanted a smaller size pin. Platinum prices increased. I contacted various manufacturers to see if they could make stainless-steel threaded wires. Rocky Mountain Metal Products Company of Denver, which sells orthodontic supplies all over the world, said it couldn't be done. At length I found a one-man orthodontic supply manufacturer in Blue Island, Ill., who was able to make a 25-thousandth-inch diameter threaded stainless-steel wire. [9] He made it on a jeweler's lathe, by hand. We started using and teaching the stainless-steel pin material for amalgam. I wanted a still smaller wire. At first he didn't think it could be done; but eventually he found a way to thread a 22-thousandths-inch diameter wire. That was a wonderful achievement, because these pins worked superbly in smaller teeth. We could use more pins since they destroyed less tooth structure. More pins distribute the load over a greater portion of the tooth. I kept after him until he produced a 19-thousandths-inch diameter pin. This is the size we use mostly now.

We always had trouble finding accurate drills of the right size to fit pins. The drills fluctuated so much that we had to match wires and drills with a micrometer. The 19-thousandths-inch pin became 19½ thousandths after it was threaded. This size just fits a hole prepared by Unitek 21-thousandths drill, which is very accurate. We buy bladed drills, 6-mm long, in friction grip and in straight handpiece. A number of these small pins at varying depths, from 1½ to 6 mm, in a tooth lend maximum strength and retention. The number of pins and their depth depend both on the stress that's anticipated and on the safety of the area being drilled. Drilling the holes to miss the pulp and furcations can be quite an exact science. By making pins of different lengths, we grasp a large part of what remains of the tooth or the root without creating a fracture zone. When the outer ends of the pins are covered with amalgam, this splints the tooth together into a strong unit. Often, if it's a nonvital tooth, we include a threaded, tapered clasp-metal endopost. A Kerr, tapered clasp metal endopost can be threaded by screwing it into gradually larger sized holes of a jeweler's die plate. One post can be threaded in 10 minutes, and makes a soundly engineered support when placed (ideally) near the apex. When surrounded by several pins, endopost and pins are bonded together and sealed against caries by amalgam--to create the strongest attachment known for a restoration or foundation (30).

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[9] *K and R Dental Products Co., Box 292, Blue Island, Ill. 60406*

Even when used for a younger patient with strong teeth, I worry about a split when the patient gets older.

CHRISTEN: How well is operative dentistry being taught in our dental schools today?

MARKLEY: There has been a trend to shorten courses. Some schools went to a three-year course, and the thing they often cut is practical restorative dentistry. Also there has been a trend toward emphasizing the biological aspect at the expense of practical restorative techniques. We need both; but some dentists have been graduated who are not able to care for the dental needs of the public. Some schools don't even pretend to train the dentists to care for people. They are making teachers of their graduates. Well, what kind of a teacher can you expect from a graduate who doesn't know how to restore a tooth? Admittedly, preventive care is the most important of all service rendered; but many students are not even well schooled in preventive dentistry. I'm fearful that much of the scientific, biological teaching in dental schools is not very practical.

LOOKING BACK ON A LIFETIME OF PRACTICE

CHRISTEN: Over the years, you have had many associates. Tell us about the background of some of the dentists who have worked with you.

MARKLEY: At the end of World War II, about 1945 or 1946, I equipped an office for a hygienist. Hygienists were difficult to find in Colorado at that time, because we didn't have a dental school. They were generally prima donnas who were inclined to fill an appointment book and then leave. But, regardless, I decided to have one. I was able to buy some slightly used equipment for her operatory. About that same time, Wilmer B. Eames came out of the Service. He had had only two or three years of practice before entering the Service. He wanted to practice in Denver rather than go back to his hometown. Both office space and equipment were scarce. He begged me to let him have that office I had prepared for a hygienist.

He was able to take referrals and see patients much sooner than I could. Ours was a very pleasant association. Later, he went on to his hometown of Glenwood Springs to practice; but eventually he developed an allergy in his hands. That made him quit practicing dentistry but he had a splendid background for teaching. He went to Northwestern University and spent some years with Eugene W. Skinner who taught him the essentials of dental research. From there he went on to Emory University where he has inspired many undergraduates to be research-minded along with dental practice (15). Over

the years, I took in a total of nine associates who came with the plan of spending two to five years of internship or postgraduate study. Each learned to deliver a superior service and I am proud of all of them. Lee Nelson, one of the most capable, developed acute leukemia and, at his demise, left a personable wife and two small children. Members of the Metropolitan Denver Dental Association, sparked by the Mile Hi Study Club, raised a fund to help his family carry on. Several of his patients returned to my practice, each with a dental service that continues to be a memorial to his dedication. (A few years later his widow married a Denver attorney, reestablishing a complete home in which his two children were included.)

My associates practiced with my equipment and supplies, but I found that to be burdensome. My more recent associates, mostly young men just out of school or from the Armed Services, came with the understanding that we would simply be good neighbors with a door between our offices. My associates have all had their own practices. I merely helped them build a practice that they could move to some other location. Our most recent (the tenth) associate, however, was chosen carefully to be permanent. Since I have now practiced 50 years. I sought to find someone with a capability of eventually taking over completely. A student, David R. Hartman, was finally found at the University of Michigan. He came to me by rather interesting circumstances.

A number of years ago, I gave a 2-day clinical program at Midland, Michigan (north of Detroit, on the lake). It's an area where a high quality type of dentistry is in demand. Several influential and important companies, like Dow Chemical, have their headquarters there. One of the participants in this course was Dr. Darl E. Pochert, with whom I continued correspondence thereafter. He then had a young patient, David R. Hartman, who had a number of restorations made when he was only 17. Eventually, David became a dental student at the University of Michigan. While there, he was taught the traditional G. V. Black type of preparation. This young student began to wonder why he was being taught to mutilate teeth in the name of cavity preparation, while in his own mouth he had some very conservative restorations! So he went to his dentist, Dr. Pochert, for an explanation. Dr. Pochert, a disciple of conservative cavity preparation, explained the importance of saving tooth strength for lifetime service. Overcut teeth can cause cracks and fractures. This approach seemed most logical to David, so he chose that subject for his junior table clinic competition. Most of his instructors took a dim view of such "unorthodox" procedure.

Dr. Pochert gave him my name, and I subsequently supplied reprints and slides to study. I invited David and his pretty young wife to come to Chicago to become better acquainted with them, and for him to be my projectionist for a lecture on the conservative amalgam restoration. It was the first time they had been out of Michigan. He brought the material he was already preparing from Dr. Pochert's coaching, plus the material we had sent. We spent a fruitful evening together. I was delighted with the quality of his material, so I loaned him the slides I had used that day, with permission to copy any he would like to use as examples. He won first prize, which entitled him to go to the ADA meeting, all expenses paid, to present his program. Well, amalgam is not the most popular subject at a National meeting so he didn't win first prize--but he <u>did</u> receive "Honorable Mention."

We were impressed with this young couple; so, while we were together in Chicago, we invited them to come to Denver the following summer to spend their vacation, to see our office, and to discuss the possibility of an association. They accepted the invitation and, while they were in Denver, we set up a contract whereby he would come upon graduation as an associate. He was to equip his own office in adjacent space, and share some facilities. I would, after two years, move out of one operatory and allow him to expand. At the end of five years, the plan was for him to inherit the practice. We are almost two years into that agreement now, and I'm perfectly delighted with the service he's delivering to our patients. They are receiving him very well. We're making it possible for him to become acquainted with almost all of the patients. So, rather than simply retiring and closing the doors, we will be able to leave our clientele who have been with us for so many years with someone who is well qualified to carry on the tradition of conservative dentistry.

CHRISTEN: On the table in front of us are photographs of some individuals who must mean a great deal to you.

MARKLEY: Yes, and some others should also be there. These photographs have been on a wall in my business office for many years. They are pictures of the men who helped me develop my concepts and philosophy in the practice of dentistry. The first, of course, was my father (Fig. 3); but we have already discussed his influence. The next photograph is of George R. Warner, MD, DDS (Fig. 6). Dr. Warner was one of those successful practicing dentists who contributed hours to teach part time at the University of Denver while I was a student. He became a guiding light in my career because he took a fatherly interest in me. He taught radiology at Denver University and, when I came back to practice in Denver,

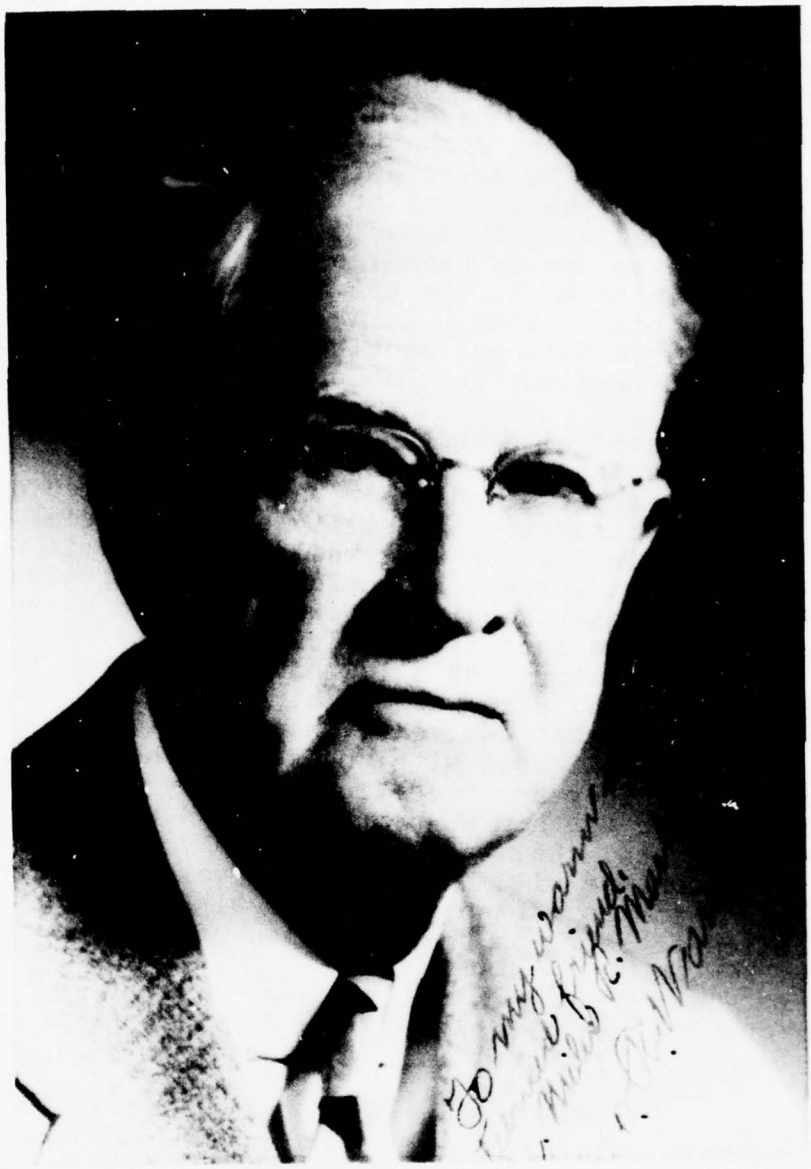

Figure 6. Dr. George R. Warner, MD, DDS, of Denver, Colo., Instructor of Dental Radiography at the University of Denver Dental School and member of the first faculty for the Fitzsimons Army Hospital Dental Intern Training Program.

became my 'father confessor.' I could go up to his office, in our building, and ask him questions. He was helpful and patient in guiding a young man beginning a practice in the city.

Dr. Warner directed a group of dentists, the Smedley Dental Group, on the 12th floor of the Republic Building. In 1937 he went to California to learn of the McCormick Technique for making dental radiographs--commonly called the long cone (or long focus) x-ray technique. After returning, he taught a course in the Metropolitan Denver Dental Study Club of which I had been elected Secretary. As such, it was my duty for several years to select faculty and plan the courses. I was also privileged to take every course given in this Study Club. Since the nearest dental school was 500 miles away, our Metropolitan Denver Dental Association undertook to provide continuing education for the area. Each radiography course lasted for one year and, at the end, the graduates were entitled to become members of an x-ray oral diagnosis seminar that Dr. Warner conducted. George Warner divided the responsibility by having members of the group put on their own program in turn. (That plan eventually killed the seminar, because now and then somebody wouldn't follow through. The members would meet, but no program was ready.) Dr. Warner was a very upright, ethical person who was prominent in organized dentistry. He was also a capable writer, and a real inspiration to all of us.

CHRISTEN: The next photograph is that of George M. Hollenback, DDS.

MARKLEY: Dr. Hollenback (Fig. 7) [10/] became my guiding star back in the early 1930's. I had just moved to Denver and brought with me memories of too many failures with amalgam

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10/ *Dr. George M. Hollenback was born on a small homestead in Kansas on September 27, 1886. His entire formal education in elementary school and high school consisted of 42 months in a country school which required a daily four-mile walk. He became interested in dentistry at age 17 when he visited an itinerant dentist to have a toothache treated. Since two years of high school or its equivalent was required before he could study dentistry, young George diligently prepared and successfully passed an examination before the State Superintendent of Public Education. He received a DDS from the University of Kansas City (now the University of Missouri at Kansas City) in 1908 and practiced dentistry in Montana from 1909-1919, then moved to Los Angeles where he practiced for 48 years. He received an MSD Degree from Northwestern University in 1945 and later a DSc Degree from the University of the Pacific.*

Dr. Hollenback became a proficient dental researcher, inventor, clinician, and teacher, publishing over 100 scientific papers in the fields of cast gold restorations, waxes, compacted gold, dental investments, impression materials, various restorative techniques and procedures, and composite resin systems. Until 1957, he conducted a full-time private practice treating many Hollywood stars and personalities, including Katharine Hepburn, Clark Gable, and Howard Hughes. In fact, Hughes helped Dr. Hollenback establish the "George M. Hollenback Research Associates" of Encino, Calif., in 1957. It housed more than $100,000 worth of research and testing equipment, much of it designed by Dr. Hollenback himself. Eventually, Dr. Hollenback donated all the equipment to the University of the Pacific School of Dentistry. He died of pneumonia in a Los Angeles area convalescent hospital on Nov. 30, 1973, at the age of 87 (20).

Figure 7. Dr. George M. Hollenback, DDS, MSD, DSc, noted researcher, teacher, and clinician from California.

restorations. Dr. Hollenback was then a dentist for many movie stars. He shared his expertise to help dentists all over the country with their restorative problems. In his practice, he had made mostly gold restorations. But in 1933, during the bottom of the Depression years, few people could afford gold restorations. (At that time, I still considered gold inlays the best restoration we could make.) He came to Denver to give a lecture, and also operated on actual patients. He showed us how to make a matrix, which was a modification of the one Black had used. The matrix was supported with modeling compound which would not adhere to a damp tooth, so a rubber dam was necessary. (I can still remember how he got a little modeling compound mixed up in his amalgam, and how disgusted he was!) Anyway, he planted some seeds of interest that later germinated. His course, together with the earlier teachings of Finn Bronner (4) on conservative cavity preparation, influenced me to build better amalgam restorations.

Dr. Hollenback was a real leader. After he was well along in years, he studied for a master's degree (at Northwestern University in 1945), for which everyone admired him. He also published many practical articles. In 1937, he taught us to relieve castings inside of their margins for cement so that inlays and crowns would go more completely to place. Without relief, no well fitted casting will seat, by some 150 microns. He showed me the dies and castings from his safe to prove it to my satisfaction. This bit of technique still isn't generally observed in the profession, but it's very important. Eames recently has done research at Emory University that confirms and updates Hollenback's teaching, which we have followed routinely since 1937 (15). At one time, Hollenback allowed me to visit him in his office in California for several days. I admired the way he was able to sit down in the laboratory and assist his technician, closely directing what was being done. This operator was "Number One" in restorative dentistry. A really great person.

CHRISTEN: Dr. Charles E. Woodbury (Fig. 8) undoubtedly has had a tremendous influence on you from a personal and professional standpoint. What type of person was Dr. Woodbury?

MARKLEY: He was a stickler for perfection. In his earlier days, he was very exacting, almost to the point of being unpleasant. By the time I knew him, he had mellowed. He was always kind to me. As secretary of the Metropolitan Denver Study Club, I invited a member of the Woodbury Study Club to come and teach a course in gold foil. Through him, I made the acquaintance of Dr. Woodbury, who eventually

Figure 8. Dr. Charles E. Woodbury, DDS, famed dental clinician, study club director, and educator. He was a personal friend and confidant of Dr. Miles R. Markley for many years.

invited me to become a member of the Gold Foil Study Club. [11] This is the oldest continuing Study Club in America. It was founded in 1906, in the name of Dr. Woodbury's father, who practiced in Iowa from 1858 until his death in 1891. The Woodbury Gold Foil Study Club program was aimed toward the practicing dentist who had a serious interest in the use of gold foil in particular, and in good restorative dentistry in general. Occasionally, we studied topics other than gold foil (amalgam, for instance). One time, Dr. Hollenback was invited to conduct the program. The group met twice a year, at either Creighton University (Omaha, Nebr.) or at the University of Nebraska (Lincoln) when there was a break in student activities. Guests might be invited to come, subject to being reinvited by the membership. A guest would be privileged to watch one operator through an entire procedure on a patient, and to listen to the lectures; or he could go around the entire infirmary and watch different operations. If he showed sufficient interest he might--in the course of time--be invited to become a participating or operating guest. Once he was invited to become an operating guest, he was assigned simple operations and eventually worked into more complicated gold-foil restorations. Generally, after several years as an invited operating guest, one became eligible for membership. Then it was necessary to spend at least 10 years (attending the meetings for two days, twice each year) to eventually become a full-fledged member of the club. This Study Group was a great inspiration to me because its membership was made up of thoughtful, conscientious, capable operating dentists, some of whom were instructors in dental schools. The same rules still apply today.

Over the years, Dr. Woodbury and I became close friends. We exchanged ideas and corresponded, and I was invited frequently to visit his office in Council Bluffs, Iowa. I have quite a sheaf of correspondence that remains from our friendship.

CHRISTEN: How extensive has your involvement been with dental study clubs through the years? What is the role of the study club in the career of the general dentist?

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[11] *Charles Elmer Woodbury (1866-1952) died at age 86 in Shenandoah, Iowa. He received his DDS from Boston Dental College (now Tufts University) in 1887, and was a member of the faculty at Creighton University from 1908-1948. Dr. Woodbury had been a diabetic since 1920, and lived by very careful dietary restrictions. He is purported to be one of the first patients to receive insulin at the Mayo Clinic in Rochester, Minn. In 1929, he published the book: The Making and Filling of Cavities in the Proximal Surface of the Front Tooth with Gold Foil(41).*

MARKLEY: An undergraduate learns just enough in dental school to enable him to go out and open an office--and really start to learn dentistry! He will then progress much faster if he will read publications in his field, and if he will listen to lectures. But the best way of all to learn is to become a member of a study club. If there isn't one, the young dentist might help start one. There are two kinds of study clubs. One is the passive type, in which you listen to lectures. For example, the Columbine [12/] Periodontal Study Club (ably led by Drs. Balint Orban and Bill Hiatt), has brought in celebrities from all over the world to give lectures and courses on subjects related to periodontology. The other type, the participating study group, combines lectures and actual operations. These operations may be performed on models or on clinical patients. The best study clubs are the ones that perform operations not only on extracted teeth (or models), but also on actual patients. In 1937, the Metropolitan Denver Dental Study Club was established by Drs. L. Glenn Cody, E. E. Bailey, Joseph Ewers, A. C. Withers, Louis Adleman, Henry Hoffman, and others. We had both types of programs. Eventually this Study Club rented a building downtown, scrounged some old dental equipment, and set up a dozen chairs--thus making available a big furnished dental office. By maintaining that office year around, we were able to put on operative and lecture study courses.

Some schools make such facilities available. The best one is the University of Oregon. I have been on their postgraduate faculty for many years. They started first in their old dental school building; but eventually, when they built a new structure, they designed a postgraduate department. It had a large room with about 20 dental units, a well-equipped laboratory, a nice conference room adjacent, and a good-sized auditorium across the hall. I have given many lectures and participating courses there because they have the best facilities in the country. That place is kept busy the year around. While I was giving a lecture course in the auditorium this year, two others were being given in the clinical division. (Thirty dental study clubs in that area use this facility!) Recently, on the campus, I was interested to see construction materials being unloaded from a truck. I was told that an even bigger and better continuing education department was being built. As far as I was concerned, they already had the best one in the country! I shall use this exciting new continuing education complex for a course scheduled in 1979.

12/ *EDITOR'S NOTE: The columbine is the state flower of Colorado.*

Many schools have continuing education departments because they feel a continuing responsibility to their graduates to keep them abreast of the changes in their fields. In our new University of Colorado Dental School, here in Denver, it was originally planned that we would have such a facility for continuing education: but the funds were cut and that facility was left out. The only way we can hold participating courses here is during vacation or holidays when classes are not in session.

CHRISTEN: How do you feel about individual state requirements for continuing education?

MARKLEY: Dentists must keep up with the changes in the profession. In this respect, they are inclined to become careless. We don't have the safeguard that medical surgeons have--their contemporaries are always looking over their shoulders in the hospitals and judging their performance, but a dentist is cooped up in his own little office, and nobody knows what happens behind those closed doors. Patients certainly don't know much about what goes on, so it has come to be recognized that continuing education is important. It's too bad that it has to be legislated. You don't get full cooperation. For a number of years in Colorado, I was on the committee which made continuing education mandatory in order for a dentist to remain a continuing member of the Colorado State Dental Society. Membership in the Society allows one to carry malpractice insurance, belong to the Study Club, attend monthly programs, and receive many other benefits. We developed a point system whereby member dentists had to accumulate a certain number of points for so many hours of continuing education, but the system hasn't been too successful. (The people who would continue to study anyway are the ones who keep up. The people who don't have any desire to learn find ways of avoiding it.)

I think the best way is to have inspiration. First of all we must select students for dental schools with the right attitude; i.e., those having the right moral sense and who want to serve their patients well. They must get into their minds the fact that the school can't teach it all. It can just give them a start. Many schools rightly feel that it's their obligation to put on continuing education courses. At one time two postgraduate students from private practice were ordered by the State Board of Dental Examiners to attend the University of North Carolina. Either they took a 6-month course at the University, or they lost their licenses. A lot of unpleasantness went along with this decree. These men were at the University just to put in their time. They were privileged to participate in the

course I was teaching, but they showed very little interest. (I think continuing study is a moral matter more than anything else. Morality is the most important thing to judge in a prospective dental student.)

CHRISTEN: In modern dentistry, there has been decreasing emphasis on the use of some of the skills involving our hands. Dentists are relying more upon turbines and handpieces as means of cutting and preparing tooth structure than upon hand instrumentation. What is your feeling about this trend?

MARKLEY: Originally, for dental burs, we had nothing but carbon steel (which is not as hard as enamel). Before my dad went to dental college, dentists had egg-beater type drills that were used on teeth along with hand instruments. When the electric motor became attached to the foot engine, it was possible to cut teeth faster, even with carbon steel burs. Diamond-covered instruments and tungsten carbide rotary instruments came on the market at about the same time. The original diamond instruments were large and clumsy, and dentists wasted tooth structure with their use. When high-speed instruments came on the market, a dentist could cut faster than he could think! The early tungsten carbide and diamond instruments were huge. In the early 1950's, when I first went to Fitzsimons Hospital, they had no burs smaller than a #2 round, a #36 inverted cone, and #702 and #703 fissure burs. They didn't prepare any cavity smaller than those burs.

When high speed came, those same burs cut cavities still larger because of bur-whip and the natural hand tremor. Full crowns became increasingly popular instead of intricate conservative preparations. Endodontics became increasingly necessary because of pulp mutilation from excessive cutting and heat. Some dentists advocated routine use of corticosteroids to defer symptoms of pulp injury.

I don't decry the use of high-speed rotary instruments. They can be judiciously used to lessen trauma of both the patient and the dentist. These instruments also lessen the drudgery of cutting enamel to open into a cavity for a conservative amalgam restoration. After opening, the preparation for amalgam should be continued and concluded with low-speed and hand instruments. This method saves tooth strengtn that would be wasted with all-high-speed preparation.

For cast restorations, a preparation can be almost entirely prepared with high-speed rotary instruments. The careful operator will cut pinholes at low speed, and will perfect margins with hand instruments.

CHRISTEN: What is your personal history in the use of rubber dam?

MARKLEY: We were taught to use rubber dam in dental school, but the way we were instructed was ineffective--and we knew it. Some of our instructors obviously didn't believe in its use. You have to believe in something before you can teach it. There were several problems. First, the rubber-dam material in those days wasn't very tough, and so it tore easily. Secondly, we were taught to apply medium thickness dams which were much too thin and too flexible to isolate a tooth. As a result, moisture seeped in, and we knew that we didn't have a clean, dry field after all. It was sort of a farce, as we saw it--an unnecessary, time-consuming exercise in futility. So, when I began to practice, I "threw the rubber dam out of the window."

A very conscientious dentist in our town, Dr. Ralph Alden (a Northwestern U. graduate), continued to use the rubber dam however. He wasn't noisy about his use of it, but simply mentioned that he believed in the value of the rubber dam. (He was later to become a member of the Panhandle Region Study Club that I directed for 23 years in Nebraska.) It wasn't until I came to practice in Denver in 1932 that George Hollenback convinced me that a rubber dam was important. By that time, I had discovered that heavier thicknesses of rubber dam didn't tear so easily. We still used light-colored rubber until dental spotlights came into use about 1940. I found out that I got better results by using "heavy" thickness of rubber dam, but eventually graduated to "extra heavy," and finally to "extra heavy special." These applications didn't tear, and would hug a tooth tightly so you could really have a dry field. I gradually went back to routine use of the rubber dam for amalgam, gold foil, tooth-colored restoratives and, in many instances, cast gold restorations.

In 1933, Hollenback taught us in Denver to make a compound stabilized matrix which could be used only in a dry field because compound will not adhere to a moist tooth. He did not consider a wedge necessary. I got overhangs, even though we used compound, and soon learned that we did need a good wedge. I also discovered that, if the wedge was placed prior to cavity preparation, it would prevent subsequent tearing of the rubber.

Bob Wolcott, at the Bureau of Standards (Washington, D.C.) demonstrated that all restorations leak, even gold foil, as a result of different coefficients of expansion between restorative and tooth (42). Mouth fluids percolate between the tooth and restorative material with changes in temperature of hot and cold foods. If there has been contamination

of the cavity before the amalgam is placed, you get more leakage, and more discoloration of the tooth substance. Eventually, however, amalgam will seal itself.

It became more and more obvious to me that one couldn't practice quality dentistry without a rubber dam. A good fitting clamp is important. Everyone has his favorites and I have listed mine in an article in Dental Clinics (30). With the heavy rubber dam, we found that a clamp wasn't always necessary. Whereas we once used ligatures universally with thinner dams, I practically never use ligatures anymore. They are damaging to the soft tissues, and are generally a nuisance. They may even cause the dam to leak by acting as a wick to carry saliva. I understand that rubber dams are not even taught by some schools. I saw evidence of this when I served on the Colorado State Board of Dental Examiners. I think that is a tragedy.

CHRISTEN: What professional journals do you advise general dentists to read?

MARKLEY: For the first 25 years of my practice, the Journal of the American Dental Association was tops. Every issue carried more than a dozen practical articles by the best dentists in the profession. More recently, the Journal of Prosthetic Dentistry, which was started in 1951, has been the most practical of all the journals. It is down-to-earth, and doesn't have the problem of having to publish neighborhood news and the workings of various professional committees. It's strictly a clinical magazine.

From a clinician's standpoint, the JADA has deteriorated through a succession of editors. Once upon a time, it largely featured clinical dentistry. It's not that way anymore, although under the present leadership there are some excellent articles. I would rather publish an article in the JADA because it reaches more dentists than any of the others. We also have our state society journals, which are good proving grounds for young writers. That doesn't mean that the state journal articles can't be good. Just as we need table clinics at dental conventions to develop clinicians, we need contributors to the smaller and more intimate journals to afford valuable experience for budding journalists.

CHRISTEN: How do you feel about women in dentistry?

MARKLEY: There's no reason why women can't be good dentists. They relate to children better than men. In some Scandinavian countries (Finland, for instance), 80 percent of the dentists are women. In other European countries there is a high percentage of women in dentistry.

Of course, a woman does have the responsibility of bearing children. I believe that the mother ought to be with her child constantly during the early years. One of the weaknesses of American society is that, in too many instances, the care of small children is delegated to someone else, to babysitters or to schools. I hate to see women go into professions feeling that they are tied to a career throughout their child-bearing and -rearing years. Yet it can be done in dentistry, because they can take time off and come back to practice again. My feelings are mixed on that subject.

Mrs. Markley was completely busy as long as our children were at home; but, once they were gone, she had more free time. She was always active doing worthwhile things. Before Ruby Zoberst--who had been important in my office for 29½ years--retired, she had trained two girls to take her place. One of them was successful, but the other wasn't, so Mrs. Markley came in to help. When the remaining girl moved to California, Mrs. Markley became the head Office Manager, directing whatever help we had. (She does have a very good educational background, with a Master of Science Degree in Commerce from the University of Denver. Moreover, she has always done the heavy accounting, even though she wasn't at the office.) My wife considers this position as a challenge. This work has also added to her understanding of the many problems that can occur in a dental office (why one can't punch a time card, can't always be at home on time for a meal, or can't get away for some social engagement).

CHRISTEN: What is the role of dental research to the private practitioner?

MARKLEY: There are two principal kinds of dental research.

The first, the very practical type, is extremely important to the profession. For example, we have pathologists who study tissue reactions to new restorative materials and pass on the findings to us. Harold R. Stanley, at the University of Florida, is our leading pulp pathologist. Dr. Balint Orban was a wonderful pathologist as far as gingival tissue reaction was concerned. Wound repair, bone healing, and metabolism: all are important topics. Every practicing dentist should be obligated to keep up to date on these topics.

Secondly, in dental research, dental materials research projects are very important; for example, those detailed in Eugene Skinner's Science of Dental Materials (37). As Skinner grew older, he collaborated with Ralph W. Phillips, an outstanding dental materials researcher at the University of Indiana (Indianapolis). They published the text together for a time, until Skinner died. Then Phillips assumed full responsibility. I have almost every edition of this book in

my collection. Ralph Phillips, now considered the "king" of dental researchers, has written many worthwhile books and manuscripts.

About the time of Dr. Skinner's death, Dr. Eames went to Emory University and set up a unique research department. He taught undergraduate students how to do dental research--thus indoctrinating the students with the importance of the connection between research and the materials which are used in dentistry. There is no department like it in any other school. Time was when it was almost unheard of for an undergraduate to give a program for the International Association for Dental Research. This year, Dr. Eames had 10 of his research students on the IADR program. I am very proud of what he has done at Emory, and believe that his prior experience in my office helped him.

There are now splendid textbooks in operative dentistry. Ralph L. Lambert, recently retired from the U.S. Air Force (currently on the faculty at Colorado University Dental School), included much of my material in his chapter entitled: "Amalgam Restorations," in Baum's excellent textbook (1). William W. Howard (18) wrote the Atlas of Operative Dentistry, which has beautiful illustrations. After practicing for 25 or more years he has now become the Chairman of Crown and Bridge at the University of Oregon (Portland, Ore.)--a wonderful asset to that University and department; for a practical teacher was very much needed. Rex Ingraham, at the University of Southern California (19), has published a splendid textbook on operative dentistry. These are practical books. I think that the best text books are written by dentists who have experience in dental practice, although a pure researcher can write a good text for reference.

CHRISTEN: What changes are needed in dental education?

MARKLEY: Well, it would be wise to add another year to dental school--in fact, a required one-year internship would be most worthwhile. At present, the field of dentistry is so broad that it's impossible to cover the clinical and theoretical subjects adequately in a four-year period. Those schools which have tried to compress their material into three years are even worse off, for they deleted much of clinical dentistry. It is important to teach a dentist to take care of the needs of the public. Much as we may try to prevent dental disease, we still must be able to treat it when we find it. We have to be able not only to recognize it, but to recognize it early when it's treatable by the most simple procedures. I think there are too many teachers and instructors in dental schools who have had no practical experience.

Actually, dentistry requires multiple talents. A dentist has to provide his own facilities (a very expensive investment), and he has to be a businessman. He must know practical psychology and how to get along with people. He must be able to do the technical part of dentistry. It's a very broad field that one can't possibly learn well in four years without benefit of an internship or continuing education. As G. V. Black said: "A professional man has no right to be other than a continual student" (2). That is why continuing education is so vital to dental practice.

CHRISTEN: You've taught courses in every state in the Union, and in countries all over the world. How many programs have you conducted?

MARKLEY: I don't know. Since the 1930's, I have devoted one-third of my time to delivering dental programs.

CHRISTEN: In which--of the hundreds of awards, certificates, plaques, testimonials, and memberships that you have received--do you take the most pride? (Fig. 9)

MARKLEY: Membership in the American Academy of Restorative Dentistry has been highly beneficial. The very best operators in the profession are members of and participants in that group. I also value highly my experience in the Woodbury Study Club.

The Academy of Gold Foil Operators has likewise been an inspiration. (I operated in their first clinical session that they held, in Miami, Fla.) Membership in the new Academy of Operative Dentistry is important, too. [13] Of course, I prize the "Man of the Year" award I received from the American College of Dentists. (Membership in that organization is, in itself, a supreme compliment.) Naturally, the Honus-Maximus Award from the Metropolitan Denver Dental Association, comprising some 650 members, is a source of pride. I'm also proud of the citations received from the Armed Forces. The one from the Army, covering my work from 1947 to 1970, is a very nice commendation. The National Consultant Emeritus Certificate from the Air Force, and my clock from the Navy--commemorating the many times I have lectured for their continuing education programs--are notable. The programs have all been rewarding, and have kept me on my toes. It is said that a teacher always learns more than his students. He has to be one step ahead of his class.

13/ At the Academy of Operative Dentistry Meeting in Chicago, Ill., Feb. 2-3, 1978, Dr. Markley became the first recipient of the newly instituted Annual Hollenback Memorial Prize awarded by the Academy of Operative Dentistry. This prize represents recognition of Dr. Markley's generous contributions to the dental profession: "which have substantially advanced the high standards of operative dentistry."

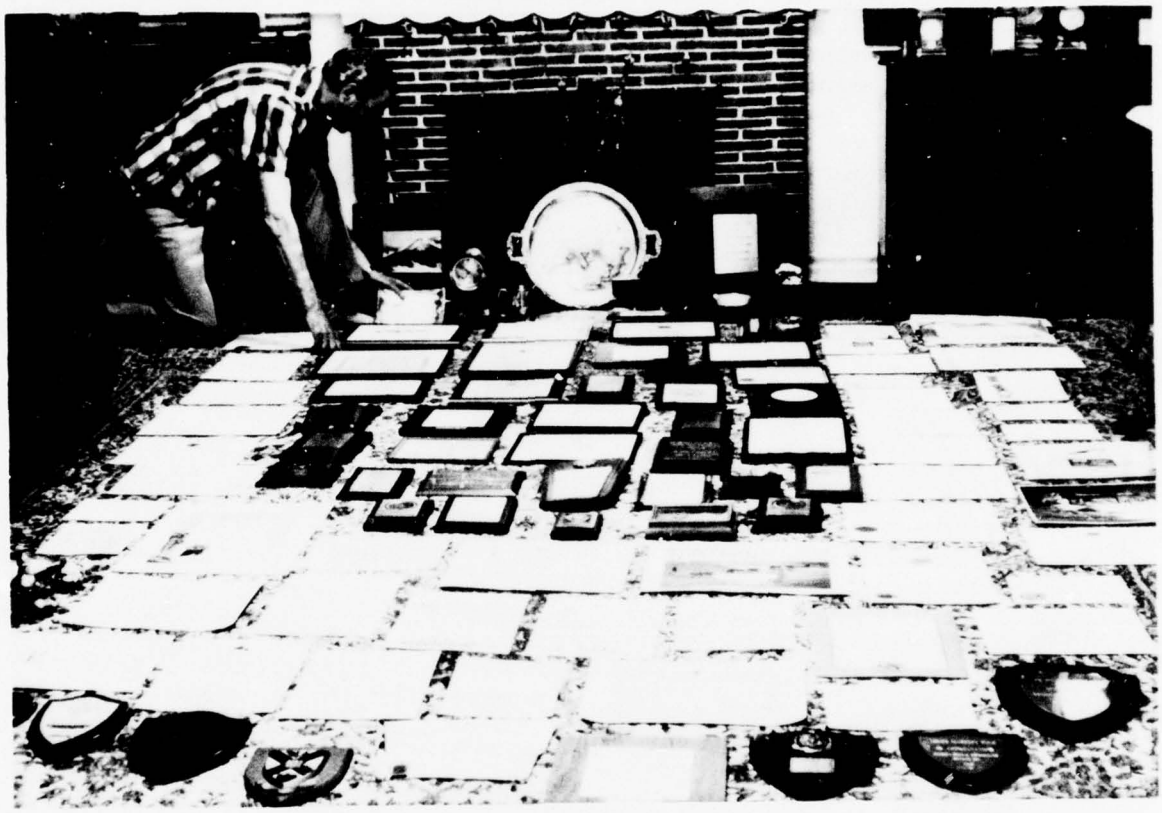

Figure 9. At the interviewer's request, Dr. Miles Markley exhibits some of the many awards and citations which he has received. (Photo by A. G. Christen)

Being selected an Honorary Member of the American Dental Society of Europe was a signal honor. I first spoke to this group in London in 1952, and later taught a full week course to the faculty and graduate students at the University of Edinburgh, where we were house guests of Dean and Mrs. John Boyes. It was also my pleasure to lecture for annual programs and local chapter meetings of this Society in Paris, Edinburgh, and Dublin. We value our many friends throughout Europe. Over the years, many of our European dentist friends have visited in our home and office.

The study groups I have directed have been a wonderful inspiration. One of the members of the Mile Hi Study Club, in which I worked for 15 years in Denver, John V. Smedley, now directs the study club in Nebraska which I directed for 23 years. [14] Please understand that I didn't start either study club--I was simply invited to direct them. In turn, a member of the Nebraska group, Donald N. Taylor, has for 15 years directed still another study club in South Dakota.

CHRISTEN: What is the role of the State Board in Dentistry? You are aware of the arguments, of course, from some dentists who feel that if you have a diploma from an accredited dental school, you should be qualified to practice dentistry in any state. How do you feel about this?

MARKLEY: I served on our own Colorado State Board of Dental Examiners for six years and so I have some perspective on this issue. In that time, I found that there were dentists who wanted to come to Colorado (considered a desirable place to live), who where quite incompetent. Until we require re-examination every 10 years, there will always be dentists who would rather move away from their mistakes than correct them. Remember, I even did that!

We see graduate dentists who simply aren't qualified to practice. We have also had schools which, despite guidance from the ADA Council on Dental Education, are still substandard. Some schools will frankly graduate a student because he has put in a certain amount of time rather than hold him over to give him additional training. In our new Colorado University Dental School, a dentist either pays a terrific tuition of something over $14,000 a year, or he agrees to spend five years in some designated area that needs a dentist--in which case he's forgiven all but about $1,800 a year. [15] The graduates are complaining about this rule.

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[14] *This Study Club was recently renamed "the Miles R. Markley Panhandle Study Club." Over the years, dentists from five states (Colorado, Iowa, Nebraska, South Dakota, and Wyoming) have participated.*

[15] *The University of Colorado School of Dentistry, Resident In-State Tuition this year (1978) is $14,403. Where graduates practice in designated areas, one-eighth of the amount is paid ($1800) and the remainder is "forgiven."*

(Colorado U. has just graduated its first class.) But, as I see it, that's the way it is and should be, provided the other professional schools are treated the same way.

Pursuing the State Board controversy further, I can remember a time when the Kansas City Western Dental School produced superb operators. They had men on the faculty who were both dedicated and inspired. The School was always short of money, and depended to a large extent on the fees the students generated. Some people argue that this policy was bad; and yet it was good in that the men who graduated there really knew how to take care of people, and also how to be industrious. Later, the School acquired a dean who was research minded and he demoted some of these very capable clinical instructors. He started emphasizing biology, and degraded operative dentistry and the clinical teaching of dentistry. As a result, the first class to graduate thereafter was terribly deficient. I was not on the Board at that time; but our Dental Examiners flunked half of the students from that School who took our Board. They simply weren't prepared to practice dentistry. As long as that can happen in a dental school, I think State Boards are important. 16/

CHRISTEN: In your travels, have you found there's a great interest in operative dentistry?

MARKLEY: Those who are interested in operative dentistry attend programs--and those who aren't are playing golf. In the Armed Forces, of course, we have a select audience, even though it may represent a "command performance." I've had pleasant receptions, generally. Occasionally one meets an individual who is obnoxious, and asks unpleasant questions; but, generally, my presentations are well received. I love to meet with study group members because they are the most dedicated people.

CHRISTEN: During your many travels all over the world, you have had to adapt a great deal to varying circumstances. Can you relate any instances which were particularly difficult or challenging?

16/ *Dr. Markley's candid and critical views concerning certain disturbing elements of the emerging dental profession and its mentors, as well as an analysis of the present dental curriculum, are supported by the recently published Proceedings of the National Dental Curriculum Conference (36). To quote an excerpt from the report: "Some current graduates appear to lack integrity, be apathetic, place excessive emphasis on monetary values, seek social status, be over-confident about their abilities and unable to make reasoned judgements about practice management and miss the essence of professionalism." Furthermore, the study identified some factors which contribute to a lack of sensitivity and professionalism on the part of the student including: "over-emphasis on technical competence, inflexible curriculum and faculty role models who teach one set of values while practicing a second."*

MARKLEY: When I was quite a young dentist, I was invited to lecture in western Colorado. Travel in those days was by train, and I sat up all night on the coach. Arriving at 3:00 in the morning in this town, I found no one there to meet me. The depot was bare and cold, and I sat there and shivered until somebody finally showed up about 8:00 in the morning. It wasn't a very hospitable reception for a day of lectures!

I also remember when I lectured to a group in California at a motel in the Carmel River Valley. We arrived early in the morning. The lecture hall was a huge dining room, with large picture windows all the way around. No preparations whatsoever had been made for my lecture. The early comers helped me scrounge blankets and bedspreads and nail them over the windows to darken the room. I remember moving the piano to serve as a projection stand. Since then, I have learned to be very specific in my advance correspondence, but sometimes find the physical equipment inadequate. Once, at the California State Meeting in San Francisco, the projector lens split and fell apart, and there was nothing to do but dismiss the group for the rest of the morning. I finally adopted a policy of carrying my own projector.

Several years ago, I was to address 750 people for a full day in Seattle for the Dean Ernest M. Jones Annual Award. [17] On my way back from British Columbia, I stopped by Seattle to see what audiovisual equipment would be used. This particular meeting was to be held in a downtown theater in order to have enough seating space. I asked them to take me down to the theater, to see what conditions I would be working under. Although we had been corresponding about it for months, I found the projection equipment entirely inadequate. As a safeguard, I then bought a second projector for backup service. (My Leitz projector cost three times as much as the carousels commonly available, and it represents quite an investment.) Fortunately the spare was not needed, but it did give me peace of mind.

Both projectors went with us on an eight-week assignment in Australia last year. On a one-day lecture assignment, I usually go by myself and carry my own equipment. On my first appearance in Fresno, California, I made a mistake.

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[17] *Since 1971, the Ernest M. Jones Lectureship has been sponsored by the University of Washington, School of Dentistry Alumni, in honor of the late Dr. Jones, first Dean of their school. From 1935, Dr. Jones was a leading west-coast teacher of operative dentistry, first at the University of Southern California (Los Angeles) and later at the University of Washington (Seattle). The Jones Gold Foil Study Club, which he initiated, is still active after 38 years and is one of the oldest dental study clubs in the nation. Dr. Markley presented the sixth lecture in the series, entitled "Saving Teeth For Lifetime Service," on Monday, Apr. 12, 1976, at the Seattle Center Playhouse.*

Usually all of the slides and equipment vital to the program are carried as cabin baggage. But, on that occasion, I packed the lens for my projector in my suitcase. The suitcases didn't arrive until the morning after I left! Meanwhile, we had scrounged another projector, and I shifted my slides from my magazines to theirs. We've now solved the problem of the several-day programs by having Mrs. Markley go along to help carry, as cabin baggage, the slides and projection equipment. This method insures that the program baggage arrives with us.

CHRISTEN: Perhaps you would care to relate the incident that happened to you in Sevilla, Spain, several years ago.

MARKLEY: Oh, yes, I'll never forget that occasion (Fig. 10)! Fortunately, it was not my first lecture there. Prior to our arrival, construction had just been completed on a beautiful auditorium with gorgeous, carpeted walkways. The seating arrangements were in tiers, thus enabling the people in the rear to see over those in front. Everything was just perfect. I had spent an hour setting up my equipment and finally everything was ready. With the group assembled, the lights were turned out, and it was time to begin. Just after they turned off the lights, I thought of something to do to the projector. So I dashed up the aisle in my accustomed manner--totally forgetting that the tiered steps were uneven. I tripped over one, and fell headlong on my nose against the next. My glasses broke, I fractured my nose, and bled all over their new carpet. They very kindly led me out to a hospital. It took a full hour to set my nose. Meanwhile, Mrs. Markley went to our hotel to get my extra eyeglasses. Fortunately, I was able to return to finish the lectures for the conference. (I had the most awful-looking face that you can imagine for two weeks.) Making the audience wait was embarrassing, but we went on with the program. Everyone was most sympathetic. [18]

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[18] *Dr. Christen's Note: A few days prior to this occurrence, I had helped Dr. Markley teach a participating course to 50 Spanish dentists at the University of Madrid, School of Dentistry (Fig. 10). Sixto Bastera, an English-speaking Spanish dentist, assisted in this course. The following day, I returned to England, where I was then stationed in the Air Force, and Dr. Markley proceeded to Sevilla. In a letter dated Nov. 14, 1974, which I received from Dr. Bastera, he gave me the following account of the incident in his quaint English:*

"I'm sorry to tell you, even though I imagine you'll know it by now, that Miles tripped on the step by the auditorium just prior to the conference, falling on the back of his nose, wounding it in three areas. Finally, I managed to convince him to go to the hospital. A dentist from Sevilla took us. After lateral x-rays were taken, the plastic surgeon detected some fracture lines. He reduced the break with two different types of forceps, packing one nostril completely and semi-packing the second. Ever since we left the auditorium to the hospital, Miles was extremely anxious, and I don't think I managed completely to sedate him, being eager to return to the auditorium. With just a one-hour delay, the conference began and was carried out perfectly throughout the day. Next day, just as he was leaving the hotel, he began taking pictures of the garden. His lower eyelid had become black, but he carried out the two-day conference as if nothing had happened."

Figure 10. Dr. Miles Markley with Professor (Dr.) Gerardo Zabala, Dean, University of Madrid School of Dentistry, during a 4-day participating course on pin amalgams to 50 Spanish dentists, Oct. 18, 1974. Dr. Zabala is an influential dentist in Spain. (Photo by A. G. Christen)

I also remember when we went to Bucharest for an International Congress. They had a big audience in a tremendous auditorium. The immediate translation provided was splendid, but their projector was simply terrible. I was finally forced to quit--which was disappointing for everyone concerned, and made me wish I had brought my own equipment.

One time in Israel, they had agreed to provide the exact projector I wanted. However, when I arrived, they had only a 10-foot cord for actuating the slides. It was necessary to ask for each slide, thus resulting in delayed action.

One of the most interesting Air Force trips was to Turkey, where we were able to visit Ephesus. We also lectured in Ankara (my second visit there). Our trips to Australia have also been wonderfully interesting. Our first trip, in 1956, was for a national congress. At that time, they provided me with a very hot projector that ruined many of my slides. My most recent trip to Australia in 1976 entailed two full months of lectures. (I carried my own projectors.) Australians are the most cordial people in the world! One of the nice things about lecturing is that you meet so many wonderful people. In fact, my hosts have been so hospitable that I have had to lay down rules to avoid being killed with kindness. On my first Air Force 30-day lecture trip to Hawaii, the Philippines, and several of the Japanese islands, I was on a very tight schedule. Traveling mostly at night, I was on duty every day and royally entertained by my hosts. Finally, I broke down physically, and had to spend a few days in the Tachikawa AFB hospital. (This indisposition made me miss my lecture schedules on one of the northern Japanese islands.) My illness was diagnosed as pancreatitis, due to stress. But just a few weeks later, General Lee Lightner, a large rugged individual, who was then head of the Air Force Dental Corps, had exactly the same experience. Later, he and I conferred and changed plans for future National Consultant visits. [19] We spread each 30-day lecture trip over a 60-day period. Three days of work were thus followed by three days of leave. A side benefit of this schedule was that Mrs. Markley could then make the trips with me, via commercial airline. My hosts were always generous in meeting her plane

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19/ *General Lightner writes: "Dr. Markley is an intense, serious-minded clinician, educator and gentleman, so frivolous and amusing incidents are not at the top of my memory. I do recall one Command Dental Surgeon's Conference in Washington, D.C., in which the National Dental Consultants were all included and participating. Dr. and Mrs. Markley stayed at our house and naturally he rode in with me to the Conference. Throughout the years, one of Miles' strongest teachings has concerned the use of the chewed end of a round toothpick to polish and clean the gingival tooth surfaces. While we were driving in to the Conference that morning, Dr. Markley was busily practicing what he preached with a toothpick. I was most embarrassed when he turned to me and said, "General Lightner, where is your toothpick?" Believe me, the next day I had it!"(22)*

and in giving us comfortable quarters. My 10 years as National Consultant were completed in this manner.

CHRISTEN: What are your hobbies?

MARKLEY: My childhood interest in gardening has continued as a pleasurable and therapeutic hobby. I have mentioned the year's supply of vegetables, part of which we consume in season and part of which we hoard for the remainder of the year. We take pride in our rock garden with its little pool and watercourse. Mrs. Markley is a member of the local rock garden society. We both belong to the Denver Rose Society and maintain a rose bed with some 200 bushes of favorites. An iris border contains over 40 named varieties. A tiny greenhouse starts a hundred geranium slips each season to supplement the perennial border and lengthen the garden season.

Three-D photography of our travels is one of my hobbies. I also make all of my own photographs for my lectures. A rather complete workshop in the basement of our home is equipped for wood and metal work and for gem cutting. This shop has also been an asset in my work. For example, a problem developed during this past year that needed to be resolved. I teach and use a very exacting technique for cast dental restorations (21). A graduate student (under Ralph Phillips, University of Indiana), George Mumford (from Australia), found that mysterious things go on within dental investment molds (35). Since wax patterns distort for various reasons, there's no such thing as an accurate casting. However, Hollenback and Rhodes (17) found that a water swager would not only adapt wax patterns closely to the die, but would also take out of the pattern many of the strains which could otherwise cause it to warp. In 1965, Gordon Christensen published a journal article, on a research project he had conducted, indicating that the water swager was an important adjunct to the casting process (6). In 1977, I had scheduled a 3½-day course at the University of Oregon, and students were to come from Israel and France, as well as the local area. This was to be the most complete course I would give that year, and included the topic of cast restorative service. Just before the course, I found that the source of water swagers had closed. Fortunately, I was able to engage a machinist to make a supply of them in my basement workshop.

CHRISTEN: You and your wife are concerned and knowledgeable about the principles for sound, healthful living. Would you describe what health percepts you routinely follow in your home?

MARKLEY: We have lived and reared our family under the influence and guidance of numerous individuals. Winnifred and I attended the University of Denver and both studied chemistry (under Drs. Reuben Gustavson, A. C. Nelson, and Essie White Cohen). They taught us key principles of nutrition.

The contributions of various people are, in fact, covered in one of my lectures on preventive dentistry. Dr. Maury Massler considers that people in our society, over the age of 25, are becoming geriatric (32). Armed Forces records also indicate that inductees start prematurely downhill, physically, after that age (10). Massler and many others consider such early deterioration unnecessary, and preventable by sound living. Addressing the Massachusetts Dental Society in 1974, Massler recommended for the geriatric (over age 25) that inexpensive meat and soup bones, pressure-cooked for 1½-2 hours, will provide a needed mineral and protein-rich broth to which later should be added a wide choice of cereals and vegetables for nutritious meals (32). The meat is deboned and the fat is skimmed off the chilled broth like ice on a pond. In our home, this stew is prepared in a 6-quart pressure cooker, then divided into portions in plastic containers, and frozen for convenient subsequent use. This recipe and many others will be found in Mrs. Markley's favorite cookbook by Adelle Davis (13): Let's Cook It Right (Chapter 17, on "Soups Are Fun to Make").

In addition to this stew, we serve 100-percent whole-wheat rolls, for which Mrs. Markley is famous among our friends. Each year, our crab-apple butter, with no sugar added, is home-processed in 3- and 4-bushel quantities and frozen for use when desired. We eat this apple butter at almost every meal, along with other garden and fruit produce. The whole-grain flour is home-ground, in our own mill, from pesticide-free wheat and rye which is grown on a farm in western Nebraska. Eggs and milk products contribute the essential elements to a complete diet. Massler teaches that geriatrics digest and assimilate the acidulated forms of milk best; specifically buttermilk, cottage cheese, and yogurt. Milk products help to provide the complete wholesome food values (including minerals) which everyone needs to maintain health and to slow the aging process. Hence we eat natural cheese, and we use the meat and broth of stewing chickens for casseroles. Our custard is sweetened with a handful of raisins.

Incidentally, the Colorado Dental Auxiliary publishes a locally popular Goody Book with wholesome recipes. The "goodies" are not, in any way, those foods which contribute

to the tragedy of our civilization's health. These recipes restrict sucrose, and the book offers sound dietary advice. 20/

A dentist can teach nothing that he doesn't practice. Good diet and dental health go hand in hand. Many families within the dental profession are now thinking and practicing dental health. We will always have nonconformers and accidents to keep dental offices busy, even though we practice and teach prevention. However, for over 30 years, we have (in our family) tried to eliminate highly processed food products to which white flour, polished rice, and concentrated sugars have been added. Once, when our daughter was hosting a tea party, she was embarrassed when a guest asked for sugar. She had to go to a neighbor to borrow some sugar, since there was none in our home. Our son, now at age 35, a professor and researcher in biophysics, makes his own whole-grain bread, restricts sucrose, and is completely well. He has never had a cavity, although he did fracture two maxillary incisors at an early age.

A daily physical fitness program directed by Michael J. Walsh (39), Thomas K. Cureton (12) and, more recently, by Kenneth H. Cooper (10), supplemented by gardening and mountain recreation, have been the personal routine for Winnifred and me for many years. We may not achieve Massler's estimated 120 healthful years as the ideal lifespan for man, but we are trying!

20/ The 225-page Goody Book, 2nd Ed., written by members of the Womens Auxiliary to the Metropolitan Denver Dental Society, is available at a cost of $3.00 from Mrs. John Frevert, 5211 So. Monaco, Englewood, Colo. 80110.

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22/ *EDITOR'S NOTE: For the convenience of the reader Dr. Markley's publications are listed here in ascending chronological order, rather than alphabetically.*

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23/ *EDITOR'S NOTE: Because the entire Review honors Dr. Markley, adding his name to this "Index" would have been superfluous.*

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