American College of Dentists

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

Fellowships and awards in dental research. The American College of Dentists, at its annual meeting in 1937 [J. Am. Col. Den., 4, 100; Sept. and 256, Dec., 1937] inaugurated plans to promote research in dentistry. These plans include grants of funds (The William John Gies Fellowships) to applicants, in support of projected investigations; and also the formal recognition, through annual awards (The William John Gies Awards), of distinguished achievement in dental research. A standing committee of the International Association for Dental Research will actively cooperate with the College in the furtherance of these plans. Applications for grants in aid of projected researches, and requests for information, may be sent to the Chairman of the Committee on Dental Research of the American College of Dentists, Dr. Albert L. Midgley, 1108 Union Trust Bldg., Providence, R. I. [See "The Gies Dental Research Fellowships and Awards for Achievement in Research," J. Am. Col. Den., 5, 115; 1938, Sept.]
American College of Dentists

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The opening session of the Twenty-Third Convocation of the American College of Dentists, held at the Sherman Hotel, Sunday, September 12, 1948, convened at 9:35 A.M., with Dr. L. R. Main, President, presiding.

L. R. MAIN, President of the American College of Dentists: It is a pleasure to call to order this, the Twenty-Third Convocation of the American College of Dentists. Meeting as we do in the City of Chicago, considered by many the center of dental progress, where education, literature and organization have achieved so much for the good of mankind and for the advancement of the profession, the College is happy to present this program in commemoration of one hundred years of progress by the largest scientific group in this country, the American Association for the Advancement of Science.

The participation by representatives of other groups in the round-table discussion planned for today indicates a community of purpose undergirding the foundation of all professional activities. The American College of Dentists is glad to act as your hosts, welcoming all to the session this morning, to the ceremonies this afternoon and to the banquet and reception this evening.

It is a pleasure to extend greetings to the members of the three societies participating in the program, and to call upon their respective representatives to extend greetings to the Fellows of the College.

DR. ANTON J. CARLSON, President of the American Association for the Advancement of Science: This is the centennial year of the American Association for the Advancement of Science. That makes us pause and ponder. We should tip our hats to our colleagues of one hundred years ago, who at that time had the vision and the courage to start the Association.

To be sure, during the first fifty years of these hundred years the scientists in America were largely sponges absorbing the discoveries of Europe. In the last fifty years, however, in all the fields of science with which I have some acquaintance, we have gradually come into our own, until now I think we can say without exaggeration that we are leading the world in science research and in science service. That means a great opportunity and a terrific responsibility for us, for our country and for the world.

The concept and the ideal of the Association for the Advancement of Science have been the unity of science. Dental science really is a part of science. Dentistry is a part of medicine. The teeth don’t stand alone any more than the tongue or the thymus. We have to understand all the machinery of the body in order to work with the greatest intelligence. We can’t understand human biology in health and disease without understanding zoology and
botany, and that includes agriculture. We can't understand these things without keeping up with and understanding, at least in part, physics and chemistry.

The more we advance, the more we see that science is the only road to the understanding of man and nature. That is the function and the aim of the American Society for the Advancement of Science. Today the Association counts a direct membership of about 50,000, starting with less than 1,000 a hundred years ago; and associate memberships in affiliated groups of over 500,000.

However, I think I can speak for the Association. I have been President of it, I have been a member of its Executive Committee for many years and am still a member; and I can say that the Association invites you dentists to more effective and direct cooperation in this unity of science and the responsibility of scientists to our country, to the human race and to the world.

We haven't yet all the answers. We have made some mistakes, but I think during the fifty years that I have known the directing brains of the Association, the leaders have worked for this purpose to the best of their understanding and ability.

In support of what I have said I should like to quote the President-elect of the American Association for the Advancement of Science, Dr. Stakman, a botanist of the University of Minnesota, whom I know well: "If science is to function effectively in emancipating from ignorance, fear and prejudice and in illuminating and enriching life—if science and technology are to help alleviate want and suffering and make living easier and more secure—then scientists have far deeper and wider responsibilities than ever before. The complexities are greater than ever before. Hence, the need for crystallizing guiding principles out of the complex mass of knowledge is greater than ever before. There must be some unity of purpose in the diversity of scientific and technologic activities."

It is that unity of purpose and responsibility which the American Association for the Advancement of Science tries to promote and tries to indicate your and my responsibility in the promotion.

Three years ago when, on behalf of the Association of Medical Colleges, I had some responsibility in founding the anti-Anti-Vivisectionist Society: the National Society for Medical Research, I invited in the interest of freedom of experimentation in biology and medicine, the moral support of the physicists and the chemists of the United States. They replied, "We have no concern with experimentation in biology." Well, I succeeded in convincing them that science is one, and they came in. This incident simply shows that the role, the function, the responsibility of the American Association for the Advancement of Science still apply even to scientists, and I would not be surprised if they apply to some members of the dental profession. We have to learn, too;
and as Dr. Stakman indicated, we should not lose ourselves entirely in our
specialty.

A few years ago I expressed the responsibility of scientists in different words,
but in essence not so different, from those of Dr. Stakman: "When every far-
mer leaves his acres a little better than he found them; when every worker
leaves the imprint of human honesty and human dignity on every task per-
formed, however humble; when every lawmaker helps to render human rela-
tions a little more equitable; when every judge leaves his court a tradition of
a little more justice; when every doctor, every teacher, every investigator works
more for understanding and less for hire; when every statesman leaves the path
of conciliation and approximate justice a little more accessible and secure, we
shall have something greater than fat cattle, marble palaces, tall buildings,
radios defiling the pure ether with black lies, and mighty airships spewing pain
and death on women and children. Even then we shall not have perpetual
health, not even perpetual youth; but we shall be well on the road to earn the
designation—wise men. We shall still struggle for life and light, but shall have
left behind the follies, the fears and the fights of the jungle."

DR. H. B. WASHBURN, President of the American Dental Association: It is
significant, I think, that this meeting, commemorating the 100th anniversary
of the American Association for the Advancement of Science, quite closely
approximates a similar anniversary of the profession of dentistry. This is our
108th anniversary.

I am particularly interested in advancing science in the field of dentistry,
especially as it relates to scientific research. As I think of the matter of scien-
tific research, I think back to the days of primitive men. I wonder how many
of you have ever stopped to consider these two factors. One is today, with
the tremendous base or backlog of information that present-day scientists have
to draw upon in any work they may contemplate entering. Then think of
primitive man. Some years ago in the Smithsonian Institute in Washington,
I examined 450 crania out of a batch of about 12,500, looking for certain things
that I was interested in at the time. I saw principally teeth worn off by the
chewing of grains and grasses—no cooked food. When, suddenly, primitive
man discovered there was such a thing as fire, he became the first research man.
He had to find out what to do with fire, and he learned in time that by cook-
ing his food he could make available many more kinds of food than he had
been used to, and that such cooked foods were better for him.

Then I thought of the matter of milk—why and how and who do you sup-
pose discovered that the cow should be domesticated for the use of its milk,
and why didn’t we tame a hyena? Primitive man had nothing to go on. That
was real research. And so when we speak of research today I think it is well
for us to remember that we have tremendous advantages to begin with.
I am not a member of the College— I am probably the only dentist in the United States who has refused membership in the College on two different occasions, so I don’t know much about your objectives; but what I have learned has led me to believe that you men are sincerely interested in doing things that will elevate dentistry, help our profession and, most of all, benefit the public.

Dr. Carlson has pointed out that when we come up to that point we not only assume a great responsibility but we certainly are faced with a serious challenge.

As President of the American Dental Association I am very happy to be here in behalf of the Association and bring you the greetings of the entire membership. We extend to you the best of wishes that you may continue your activities in your chosen field. As I look at your program for today, it gives every evidence that you are doing just that.

DR. ALLAN G. BRODIE, President of the International Association for Dental Research: It is a privilege for me to bring the greetings of the International Association for Dental Research to the American College of Dentists in commemoration of the 100th anniversary of the American Association for the Advancement of Science.

The birthdays of your College and of the Association that I have the honor to represent, coincide, both having been founded in the year 1920. The founders of both societies were of similar stature, and there were a number who took part in both events. Many of those men, fortunately, are still alive and on an occasion like this it must be a source of great gratification for them to see the fruits of those efforts of twenty-eight years ago.

The International Association for Dental Research has grown from a handful of men to a membership of nearly 700, with sections in all of the major centers of this country and in many foreign countries. It is a matter of record that practically all significant dental research in this country for the last twenty years or more has been promoted by and has traveled from or through the channel of that Association.

With the rapid increase in this interest in dental science, the years ahead look very bright. We expect an ever-expanding membership; we expect a more intelligent and a wider interest in dental research; and while we never hope to catch up with the American Association for the Advancement of Science so far as numbers are concerned, we expect to be able to add our small bit to the cumulative knowledge that is the aim of the scientist, regardless of the field in which he labors.

In his quotation this morning Dr. Carlson referred, however, to something else of which I think we all too frequently lose sight. Dentistry in America, until the turn of the century at least, devoted itself largely to the technological phases of the work, and with such intensity that American dentistry became a hallmark for the world. It realized about that time, however, that the tooth
was a part of a living body. Technical procedures, regardless of how excellent they might be, must be brought into conformity with a living organism. American dentistry almost exhausted the possibilities of the technological, and then turned to biological science.

Today it seems that all science is pursuing the material in research and paying too little attention to certain other values that are equally important: certain ethical values, certain social viewpoints, certain aspects of the results of scientific endeavor. These are too generally neglected. Unfortunately, there has been a strong tendency for the scientist to dwell in an ivory tower, to feel that his science is an end unto himself, that his contribution, once made, absolves him from all further responsibility. The tendency is to pass that responsibility on to other men.

In recent years, particularly since the bomb exploded over Hiroshima, there has been borne in upon scientists the idea that they have put these tools into the hands of men and have found their response to them not all that they had hoped. There is a growing conviction that the searchlight of science must now be turned in another direction; just as dentistry turned from the mechanical toward the biological. The scientist of today not only must be concerned with the material aspects of his investigation, but must stop to realize the implications of the results.

Through the fact that the International Association of Dental Research has been invited to bring your group greetings this morning, we have these two situations represented. On the one hand I represent scientists who, as I say, have been too closely confined to intensive investigation. On the other hand, there is the American College, which has, I believe, as one of its purposes the promotion of the more ethical conduct of the profession. It must always be remembered that when a profession neglects its spiritual values, it sinks from the level which society expects of a profession and tends to become a trade.

I hope that the next hundred years will find these two paths of endeavor side by side, and that the association between your College and my group will become ever closer.
One of the significant advances made in the administration of the art of dental practice during the first half of the twentieth century has been the introduction and expansion of certain types of auxiliary dental personnel. This personnel is now being utilized extensively by members of the dental profession in order to ensure the distribution of a greater quantity of oral health care. To accomplish this purpose, the members of these auxiliary groups are trained to perform certain prescribed tasks which it is believed can be delegated with safety to persons of lesser general qualifications than those possessed by the dentist. This purposeful modification of dental practice by the deliberate actions of the dental profession is of such a nature as to call for the thoughtful review of its present character and of its ultimate possibilities.

A study of the history of dentistry during the past century reveals an impressive story of the struggle of dental leaders to maintain dental practice on a high level of scientific quality. Dental educators have, from the beginning of institutional dental education, recognized the inseparable relationships of the basic sciences and of the dental art, and they have striven to maintain a well-balanced dental curriculum which would ensure a thorough scientific education and a high level of skills in dental practice. At times, the force of public demand for restorative dentistry has resulted in subordinating, to some degree, the importance of the biological implications of practice and in emphasizing the more immediate necessity for the utilization of technical procedures in oral health care. But in spite of these defections, dentists have gradually given more and more attention to the application of biological principles in
the clinical care of patients. This enlightened approach to the problems of oral health care has increased the chair time of the dentist, and has decreased the time he should devote to certain minor oral operations and to the processing of technical appliances which are invaluable aids to the oral health of the patient. To meet this situation, the dental profession has sanctioned two auxiliary groups which are trained to serve as aids to the dentist: namely, the dental hygienists and the dental prosthetic technicians. It is highly important that these adjuncts shall be so qualified and their services so correlated with the work of the dentist that the health and welfare of the patient will not be jeopardized.

The dental hygienist movement originated in the first quarter of the twentieth century and has advanced to the point where the demand for the hygienist's services probably exceeds the current supply. The latest available figures indicate that there are about 5700 dental hygienists employed in dental offices, in public health work, and in public school dental clinics throughout the forty states in which they are now licensed. In order to begin the practice of her art, the dental hygienist is required to complete a formal curriculum of one or two academic years of instruction which equips her to perform limited intra-oral operations, and which prepares her to take an examination for license to treat patients under the direct supervision of the dentist.

The functions of the dental hygienist are prescribed by law and are usually limited to the cleaning of the exposed surfaces of the teeth above the free margins of the gums. In some states, the law permits an extension of the hygienist's services beyond that of cleaning the teeth, but her duties are generally limited to this one operation. The important thing is that the hygienist is licensed to perform an intra-oral operation which brings her into direct contact with the patient, and makes her directly responsible in part for the oral health of the patient. In order for her to meet the responsibilities implicit in her position, she must be thoroughly aware of the health implications of her task; that is, she must have an understanding of the meaning of health, of the health relationships of the teeth to their supporting tissues and of both to the body as a whole. These requirements imply that the hygienist must have a reasonably sound scientific education, that it must extend beyond the simple mechanical procedure of cleaning teeth, and that mere expertness in the manipulation of instruments in cleaning teeth is insufficient proof of her competency as a health worker. The formal curriculum designed for her complete professional education must be accepted as evidence of her qualifications to assume duties that were formerly reserved by law to the dentist.

The requirement for admission to the hygienist curricula is graduation from high school. The average age of high school graduates is about seventeen and one-half years. The high school curriculum is planned to give the student only a general understanding of the meaning of the sciences. The subject
matter in the several subjects is so elementary that it does not prepare the student to plunge immediately into the study of advanced science courses, or of courses in which the basic sciences are applied. Therefore, the immaturity of the applicant on admission to the hygienist school, both chronologically and intellectually, is such that the student will not be able to accomplish much in the several basic science courses in the hygienist curriculum; also, the science subjects now included in the several hygienist curricula are so varied, so sketchy, and in their nature so highly technical that a high school education is an insufficient prerequisite for their study. Obviously the plan of hygienist education as it has been administered, and as it now exists, can lay no claim to genuine educational values. The situation awaits a courageous stand that will require a reasonable amount of college preparation before the applicant may be admitted to study. The leaders in dentistry may well give energetic thought to a revision of the whole scheme of the dental hygienist problem: in the advancement of educational standards, in the revision and rationalization of the curriculum, in the broadening of the professional functions of the graduate and in the adjustment of dentist-hygienist professional relationships—all these in the interest of a better prepared product and a more serviceable health agent.

The dental prosthetic technician movement originated before the turn of the century but has assumed, literally, colossial proportions during the past thirty years. The dental technician performs certain extra-oral tasks assigned him by the dentist, and since he does not come in direct contact with the consuming public, he is not licensed by the state. He may be trained in schools for dental technicians, or he may be developed under the apprentice system of training in the large numbers of so-called commercial laboratories which serve the profession. The apprentice system of training accounts for the great majority of the large number of dental prosthetic technicians now serving the dentists of the United States. There are no basic standards of admission, of length of term or of content of curriculum in the many proprietary technician schools, nor is there a standard training program in effect among commercial laboratories. The four non-proprietary schools for dental technicians require high school graduation and a prescribed course of study of two academic years.

The supply of dental prosthetic technicians employed in the commercial dental laboratories and in private dental offices, plus those in training in the technician schools and the commercial laboratories of the country, represents a potential far in excess of the needs of the dental profession. The latest available figures indicate that there are about 32,000 dental prosthetic technicians of varying ranks recognized by the rating standards of commercial laboratory organizations. The last report of the Council on Dental Education on student technician training showed in 1947 that a total of 7607 students
were enrolled in four non-proprietary technicians schools, in nineteen proprietary technicians schools, and in the string of commercial dental laboratories which stretch across the country. Of these students, 244 were in approved schools for technicians, 2391 were in proprietary technicians schools, and 4972 were in commercial laboratories. Most of the students were in training under the G. I. Bill of Rights. Contrast these numbers with the total enrollment of 8871 dental students in all the dental schools of the United States in 1946–47!

The dentist should be aware that, in the interest of scientific denture prosthesis, he should direct each step in the processing of the denture; that the planning of the case and the supervision of its construction should be done by the dentist; and, above all, that belt-line prosthesis is not in the interest of the public welfare. The dentist-technician relationship should be such that the dentist is in constant contact with each case being processed, and he should maintain full responsibility for its progress. To do this, there must be a physical arrangement in which the technician will work alongside the dentist; this means that the current relationship of the dentist and the technician should be altered in such a way as to bring the technician directly under the supervision and control of the dentist. It also means that in the future, student technicians shall be selected on a basis of aptitudes and vocational interests; that they shall have a good high school education, including certain formal training in basic and related sciences, in order to develop certain attitudes and habits of thinking that will actually make them more useful; and that they shall have a basic training in dental technology of at least two years. If auxiliary personnel is actually needed to aid the dentist, then the personnel should be so conditioned by formal education and effective relationships that they will be most useful in the production and distribution of oral health care.

In view of the importance of the relationships of these two auxiliary groups to dental practice and of the importance of their contributions to oral health care, there is good reason for the profession to be concerned with the qualifications of persons who enter these fields, with the numbers that are actually required to serve the profession, with the character of the programs of education under which they are trained, with the public responsibilities each may assume, and with any desirable alterations of their relationships to the dentist which might affect the health and welfare of the public.
ROUND-TABLE DISCUSSION

TWENTY-THIRD ANNUAL CONVOCATION, THE AMERICAN COLLEGE OF DENTISTS
Sunday, September 12, 1948

Subject: Dentistry in the Field of Science: Present Activities, Future Possibilities

Moderator: ISAAC SCHOUR, D.D.S., M.S., Ph.D., Sc.D., Secretary, Dental Section, American Association for the Advancement of Science.

DR. SCHOUR: Before starting this round-table discussion, I wish to formally thank the American College of Dentists for its foresight and its interest in organizing this special program to commemorate the centennial of the American Association for the Advancement of Science.

I think all of us are especially privileged in the fact that Dr. Carlson came in person to give the greetings of the American Association for the Advancement of Science. As you know, he was president of the Association a year ago; but more importantly, there is no question that in the history of physiology Dr. Carlson’s name will probably follow that of Claude Bernard. Claude Bernard has been established in history as the father of experimental medicine. Dr. Carlson is responsible for a greater number of heads of physiology departments in the United States and elsewhere than any other living person.

As Dr. Carlson pointed out, science has made rapid strides in the last hundred years, particularly in the last fifty years, and it will continue to expand at even greater and more accelerated rates of progress. Not many of us are going to witness the second centennial celebration of the American Association for the Advancement of Science. However, we can each in our own way help to pave the progress for such advancement as will be celebrated a hundred years from today.

Before starting the discussion I would like to present the members of our panel. To my extreme right is Dr. Walter H. Wright, who received from the University of Pittsburgh his dental degree and also his Doctor of Philosophy degree in Anatomy. Dr. Wright was professor of anatomy and of prosthetic dentistry at the University of Pittsburgh. His talents, however, have taken him into administration as well. He is now Dean of the New York University School of Dentistry.

Next to Dr. Wright is Dr. Basil C. Bibby, who is another illustration of how dentistry calls for service in a number of fields and for a number of talents. Dr. Bibby, a former Dean of Tufts Dental School, is now Director of the Eastman Dental Dispensary. Dental research and education are frequently inseparable. Dr. Bibby has shown equal interest in each, and in view of his recent appointment we are looking forward to a happy coordination of both at the Eastman Dental Dispensary.
Next to Dr. Bibby is Dr. Holmes T. Knighton, who is Professor of Bacteriology at Washington University. Dr. Knighton's training and experience are rich and extensive. A graduate of Tulane University, he has practiced general dentistry, served in the United States Public Health Service, interned at Forsyth, been a Fellow at the University of Rochester, and taught in several dental schools. His special interest has been in the problem of oral infection and its control.

To my immediate right is Dr. Lloyd E. Blauch, who is at present Chief of Education in the Health Professions in the United States Office of Education. In this capacity he has responsibility which covers medical, dental, pharmaceutical and nursing education. He is a teacher and leader of Napoleonic stature, and the editor of and contributor to two monographs in Dental Education: “A course of Study in Dentistry” and “Teaching in Colleges and Universities, with Special Reference to Dentistry.” Through his energy and enthusiasm dentistry has been able to serve the science of education not only by taking care of its own problems but by contributing to the handling of similar problems in other professions.

Immediately to my left is Dr. James Roy Blayney, a meticulous investigator who has spared indeed no effort in guiding and training a number of leading teachers and investigators for dentistry. Dr. Blayney is Director of the Walter G. Zoller Memorial Dental Clinic of the University of Chicago.

Next to Dr. Blayney is Dr. Allan G. Brodie, who was introduced earlier by Dr. Main as the President of the International Association of Dental Research. Dr. Brodie could be introduced to us in a number of ways—as a teacher, a researcher, a clinician, and an administrator. It would be difficult to establish in which capacity he excels, since he has served dentistry with equal distinction in each of these fields.

Next to Dr. Brodie is Dr. Paul C. Kitchin, who is Professor of Dentistry at the University of Ohio and has shown versatility in histology, physics, bacteriology and other branches of science. In addition, wherever there has been a call for leadership on the highest level, Dr. Kitchin has served with distinction. He was Secretary of the Dental Section of the American Association for the Advancement of Science for five years, and I had the privilege of succeeding him. He is now the Chairman of the Section on Dental Studies of the United States Public Health Service.

To my extreme left is Dr. John W. Knutson, who is senior dental surgeon and dental chief of the States’ Relations Division of the United States Public Health Service. Dr. Knutson has done classic work in the field of public health, in respect to both research matters and clinical therapy. Science exacts of its followers both discipline and imagination. Dr. Knutson has combined mathematical discipline with great vision.

With this brief introduction we are ready to start our program. We shall
follow the sequence as indicated in the program, and shall start with several questions addressed to Dr. Knighton in relation to antibiotics and chemotherapy.

Dr. Knighton, what is the present status of the sulfonamides and penicillin in dentistry?

**Dr. Knighton:** Innumerable reports have appeared in dental literature relative to the prophylactic and therapeutic values of sulfonamides and penicillin. Many of these reports have been overly optimistic due chiefly to two facts: first, the results were based on clinical impressions without sufficient control cases; and second, temporary relief of clinical symptoms was interpreted as cures. On the other hand, the publication of many worthwhile reports and critical reviews aids one in arriving at certain conclusions as to the value of these agents.

First, sulfonamides and penicillin are effective only against infections due to susceptible organisms, and neither agent is entirely free from potential toxic manifestations. Thus, an application of the principles of correct diagnosis is very important.

Second, penicillin is less toxic than the sulfonamides, and in general has a more important place in dentistry.

Third, probably the most important dental roles of penicillin and, to a lesser extent, the sulfonamides are: (a) in the treatment of acute infections—for example, cellulitis caused by hemolytic streptococci and osteomyelitis due to *Staphylococcus aureus*; and (b) as agents for premedications to control bacteremias following surgical operations in patients with lowered resistance due to systemic involvements.

Fourth, in the field of periodontia, penicillin is preferable to sulfonamides, but in either case the medication must be considered as an adjunct treatment. The chief benefit in periodontal lesions is the relief of acute clinical symptoms; cure is effected only by the removal of multiple predisposing factors which are not controlled by these agents.

Fifth, in root-canal therapy penicillin is preferable to sulfonamides, but in neither case is it safe to depend upon these agents unless checked by sterility tests, because of the possibility of encountering resistant organisms.

Grossman's report in the *J. A. D. A.* (37: 141-48, 1948) seems to indicate that the use of 600,000 units per c.c. of penicillin in peanut oil is one of the most effective methods of using this antibiotic in root-canal therapy.

**Dr. Schour:** Dr. Knighton, when we consider chemotherapy and antibiotics we also think of tyrothricin. Are there any clinical data on the value of streptomycin and tyrothricin in treating lesions of the oral cavity?

**Dr. Knighton:** In the thirteenth edition of *Accepted Dental Remedies* (1947) it is stated that nothing is known of the usefulness of streptomycin in dentistry. There is still not enough information available to reach any con-
clusions, but some experiments undoubtedly are under way. For example, Grossman (loc. cit.) states that he has experiments under way for the evaluation of a mixture of streptomycin and penicillin in root-canal therapy.

Likewise, evidence is not yet sufficient to properly evaluate tyrothricin's place in dentistry. Tyrothricin is for local use only, and does not have as wide a range of usefulness as does penicillin.

Cannon, in the Pennsylvania State Dental Journal (14: 291–300, 1947), indicates that tyrothricin used in conjunction with thrombin may be preferable to sulfonamide-thrombin mixtures in selected postextraction cases. Cannon also suggests the possibility of beneficial results with the tyrothricin-thrombin combination in Vincent's infection, gingivectomy and gingival treatments if severe bleeding is anticipated.

It must be recalled, however, as stressed for penicillin, that one can hardly expect antibiotics to serve as more than an accessory in the treatment of periodontal lesions.

DR. SCHOUR: With reference to these new treatments, there is, of course, the possible danger of expecting too much from these methods of treatment or of indiscriminate use. Is there evidence in that direction?

DR. KNIGHTON: Yes, of course. The possible toxic manifestations of sulfonamides have been adequately stressed in dental literature and are generally appreciated by dentists. While penicillin, and possibly other antibiotics, are less toxic than sulfonamides, still they are not entirely free of toxic manifestations, a fact that should be considered by the dentist before using antibiotics needlessly.

Another well-stressed point of danger is the possibility of producing organisms resistant to an antibiotic, thus interfering with the subsequent value of the agent.

One should realize that many organisms developing a resistance to penicillin may revert back to susceptible strains; so this point alone should not serve to prevent the dentist from using penicillin in indicated cases. However, the possibility of developing resistant strains, even if only temporarily so, should influence him in being more careful in diagnosing cases so as to prevent the needless use of penicillin.

There are other important dangers in the indiscriminate use of antibiotics which have not been adequately stressed. The dangers I have reference to are those of forgetting the need for an adequate diagnosis and of failing to realize the limitations of antibiotics. This point was expressed very well by Hoffman (J. A. D. A, 34: 89–99, 1947), who stated that the real clinical danger of penicillin lies in its low toxicity. It is so easy and safe to use that it may be employed without regard for correct diagnosis and proper dosage, and with a neglect of the well-established principles of medicine, dentistry and surgery in the management of disease.
This observation is especially true in the treatment of periodontal cases if the temporary relief of acute clinical symptoms is regarded as a cure. In such cases, unless the necessary correction of various predisposing and exciting causes of the lesion are removed, there will be a high percentage of chronic cases developing.

Dr. Schour: What further research do you believe is needed and may be expected in this field?

Dr. Knighton: So far, research in the field of penicillin and antibiotics has benefited dentistry, and the development of more types of antibiotics will be taken advantage of by dentistry, as laboratory and clinical evidence indicates their use. Additional beneficial antibiotics will undoubtedly be used in combinations and as alternates in combating organisms resistant to any particular antibiotic.

However, it is doubtful that dentistry will be revolutionized by continued research in the field of antibiotics because so many oral lesions are influenced by numerous factors other than bacteria alone.

In closing, I would like merely to mention the fact that the antibiotic effect of the already existing oral flora may (and probably does) exert an inhibitory effect on numerous transient bacteria entering the mouth. The difficulty of isolating so many of the oral strains, the large number of combinations possibly exerting an antibiotic effect because of a synergistic action, and the inability to produce conditions exactly as found in the mouth, all combine to make this subject a very difficult study. Yet I wonder if such a study, on a wider scale than has been attempted so far, might not reveal some very interesting information.

Dr. Schour: Dr. Blayney, will you please attempt a summary of the investigative work on dental caries up to the present time? I realize it is a large order, but I know you have taken many larger orders.

Dr. Blayney: It is a large order to attempt to review briefly the investigative work on dental caries. I think we might say that Dr. W. D. Miller is the father of the scientific era in dentistry, particularly as it refers to the understanding of tooth decay. Closely associated with Miller is the work of Black, Williams, Goadby, and a good many others.

I think the reasons why the interest in investigation of dental caries waned at that particular time were due to the fact that dentistry was not very well prepared to carry on further the work of such men as Williams, Black, Miller, and also that there was no particular or definite solution offered as to the cause of tooth decay.

I believe great credit is due to Dr. Bunting and his group not only because they called our attention to the acidogenic microorganisms associated with caries, but because their work was very instrumental in the revival of our interest in caries research.
As a result of the work of the Michigan group, many different avenues of science were opened—a continuation of the work in bacteriology, a consideration of the fields of chemistry and nutrition, a study of the physiology of saliva, and the study of dental caries from an epidemiological point of view by Kline and Palmer, and Dean, and all of their associates.

The literature in bacteriology is extremely voluminous. It would be impossible to review that entirely. However, I believe I am correct, at least in so far as I am aware, in saying that everyone, with possibly one exception, is agreed that tooth decay is the result of bacterial activity. Maybe this one group that have been holdouts in this regard have changed their minds; however, if they have, I am not aware of it.

I know of no one who definitely has been able to apply Koch's postulate to the problem of tooth decay. In general we might say that at the present time there are two main divisions in the bacteriological field, that is, those who hold with the acidogenic theory and those who hold to the proteolytic processes that first initiate the carious process.

For the past few years we have had the unusual opportunity of working with a group at the University of Notre Dame, under the direction of Professor James A. Reyniers, in the conduct of the study of tooth decay by the use of germ-free animals. In other words, the rearing of animals under germ-free conditions, and then, following the weaning period, subjecting them to a caries-producing diet. The incidence of caries observed in these animals is compared with that found in control animals on the same sterilized diet that are not germ free.

Up to the present time we never have been able to demonstrate by clinical means a definite caries process in any of the germ-free animals. We found one animal that presented a tooth which was badly broken down. We did not consider this to be a carious lesion because we were unable to discover bacteria in the dentinal tubules, a condition which, of course, is common in our histological preparations of caries.

The animals living under normal laboratory conditions, but consuming the exact type of sterilized diet, at 100 days show an incidence of caries of about 62 per cent. At 150 days they show a caries incidence of about 95 per cent.

The molar teeth of the germ-free animals are studied not only by clinical methods but by microscopic examination as well, because we believe that a very minute lesion, so small it cannot be visualized grossly, is just as important as a larger lesion. We have not been able to complete the microscopic examination of the teeth of all our germ-free animals; however, all specimens studied so far have been caries free. I mention this finding now because we believe this method is a very important means of determining whether or not caries is the result of bacterial activity.

I believe this process or this technic of investigating caries will determine
whether it is developed as a result of proteolytic action or is a result of decalcification.

Chemistry has played a very important role to date. Chemistry has explained the reaction within the tissues in the carious process. It has explained the mechanism for the degradation in carbohydrates which results in the decalcification of the tooth. Chemistry has explained the how and the why of the apparent immunity of some people to tooth decay. At the present time chemistry is playing a very important role in the development of therapeutic or, perhaps I should better say, prophylactic measures for the prevention of tooth decay.

As a result of the Michigan work, nutrition has come to have a very important place in our consideration of and research on caries. We believe it is important to consider the nutrition of the individual as a whole, and not as one particular part. However, it is very important that we consider the role nutrition plays in the production of tooth decay after teeth have been well formed.

Again, it was chemistry that first called to our attention the fact that the use of sodium fluoride in the diets of experimental animals is very active in the reduction of the incidence of tooth decay in laboratory animals.

The work in pathology, particularly histopathology, goes back to the time of Williams. Following Williams’ work very little has been done to advance our understanding of the pathological lesion. However, I must say that Dr. Nuckolls and his group at California are now presenting material which differs from the work of Williams, particularly in regard to the initial lesion in the enamel.

The work of Klein and Palmer and of Dean and his workers played a very important role in calling the attention of the dental profession, and the public as well, to the prevalence of tooth decay, how serious it is, and the type of problem dentistry has before it. They have brought to our attention sufficient evidence to demonstrate that we cannot depend entirely upon corrective measures, but that we must go further and think of preventive measures.

I realize, Dr. Schour, that this is a very hurried review of the investigative work that has been done to date, but I would like to have you carry away the thought that many different fields of science are now concentrating efforts upon dental caries.

DR. SCHOUR: Dr. Blayney, you mentioned bacteria as playing a role in the carious process, and especially your new findings in studying the animals that were raised on a germ-free environment which bear out that theory. What microorganism would you say is the active cause of caries?

DR. BLAYNEY: I cannot say at the present time what microorganism is the cause of caries. That problem is something that must be studied a great
deal more before we shall be able to provide the answer. It may be that more than one microorganism is responsible.

In our germ-free work we are now adding to the diet of animals, during the suckling period, a known strain of lactobacilli, to observe the effect it will have upon the dentition of animals that are otherwise germ-free. It will probably take the addition of a good many different organisms, at least the trial of a good many different organisms, before the answer can be determined.

In the study of the bacterial plaque upon the tooth we find many organisms which have the power of producing acid: namely, the lactobacilli, certain acidogenic streptococci, the diphtheroids, some staphylococci, and certain strains of Sarcina. We know that there are organisms within these different groups that possess the power of forming an acid. In the germ-free work it will be necessary to add different types of proteolytic organisms, probably in combination with the acidogenic organisms, before the question of responsibility can be answered. At the present time I would not undertake to say what microorganism is responsible for dental caries.

DR. SCHOUR: Would you say there may be a question about which bacteria are responsible? There is one point upon which we all agree, and that is the tremendous challenge of dental decay. How do you think the profession could best meet this obligation to society?

DR. BLAYNEY: I believe that throughout the healing arts, investigative work can go only so far ahead of clinical practice, and then there must be a rest period, giving time for the clinical practice to catch up with the laboratory investigation. I think that is one of the reasons why there was a halt to the work of W. D. Miller, Black and their co-workers.

At the present time, I am afraid, there may be a lag in our interest in tooth decay if the clinical practitioner continues to consider the treatment of tooth decay purely as a corrective measure. The United States Public Health Service has shown that decay is occurring much more rapidly than corrective measures are being provided. I believe it is the responsibility of the dental profession to think of tooth decay as a preventable condition and to practice from the standpoint of prevention rather than the standpoint of correction.

We have at our disposal today certain means by which tooth decay can be prevented. One of them is the education of the patient. I have found that patients are always interested in knowing what they themselves can do to prevent additional carious lesions. Such instruction can be accomplished only by taking time to teach the patient, when he is in the dental chair, what his responsibility is.

Dentistry cannot continue to treat caries by filling all of the cavities that are obvious, either grossly or by roentgenological evidence, and then dismissing the patient by saying, "Come back in six months and I'll see how many more
cavities you have.” That is too frequently the practice, gentlemen. At that time the patient should be informed as to the roles that nutrition and correct oral hygiene play in the prevention of caries.

I think of tooth decay as standing on three legs: one of those legs is bacteria; the second leg is the susceptible tooth (we are working on that with fluorine); the third leg is nutrition. The patient must be taught what types of diets favor caries and what types of diet do not favor the rapid progress of tooth decay. Patient education is the responsibility of every dentist.

Suppose we should compare the practice of dentistry today with the practice of cardiology or with the practice of physicians who devote themselves to metabolic disturbances. We dismiss our patient with the statement, “Come back in six months and I’ll see how else I can help you.” Physicians do not practice that way. After a patient has been dismissed from the hospital following a diabetic coma, physicians do not say, “When you get another attack and go into a coma again, I’ll see what I can do.” They carry that patient along at very frequent intervals to see that he is following a very carefully recommended regime.

I believe, Dr. Schour, that it is one of the responsibilities of the dental profession to practice dentistry in that same manner. When we do, utilizing the information which research has placed at our disposal, I am confident that 75 per cent of tooth decay can be prevented.

DR. SCHOUR: As Dr. Carlson and Dr. Brodie pointed out this morning, our problems are beyond teeth. We know that even the patients who may be fortunate in being caries-free may still have problems that turn them to dentistry—those related to the development of the teeth and the face; therefore we are looking forward to Dr. Brodie’s discussion of this important aspect of dentistry. Dr. Brodie, has dentistry made any significant contribution to present-day concepts of head and face growth?

DR. BRODIE: No one will deny that caries is strictly a problem of the dental profession. The same might be said of investigations of the other tissues of the mouth. But it is rather surprising that the problems of facial growth and head growth, which one would logically expect to be in the province of pediatrics and related fields, have been markedly neglected by them. I can answer the question by saying that the most significant contributions to our knowledge of head and face growth for the past twenty years have been made by members of the dental profession.

Progress in any field of science depends almost entirely upon the development of appropriate methods of investigation, and for a good many years some of the methods that were employed in this field were the same as those that had been in use two hundred years ago.

Vital staining, for example, in which an animal is fed material for which growing bone has an affinity, goes back to Belchier in 1736 and, following him, to
Duhamel in 1739. Duhamel was not a scientifically trained man; he was a lawyer by profession, but as a hobbyist he was one of the world’s greatest natural scientists, a breed of which we see nothing today. It was Duhamel who laid down the general principles of bone growth—feeding swine and fowl a madder-root diet, and subsequently sacrificing the animals to determine the sites at which bones grew.

John Hunter followed him some twenty years later, verified most of his work, and extended it further; and then the method went into discard for almost 150 years. This is one avenue of attack that the general investigator has picked up and used again. I shall refer to it again in a moment.

The middle of the last century witnessed the rise of microscopy. This placed the cell in the center of the stage as the agent responsible not only for growth but for all other bodily activities.

An interest in craniometry developed among physical anthropologists such as Camper, Saint-Hilaire, more recently, Todd, and, finally, that great dentist, Milo Hellman. Hellman probably has done more than any other man in the employment of direct measurements.

There is, however, always a shortcoming in every method of investigation. In vital staining it is necessary to sacrifice the animal. If dead skeletal material is of the human type, it is necessary to attempt classification of large masses of material, and in growth investigations, of course, to attempt to ascribe the age at death. In the absence of histories, it is therefore necessary to divide the material into appropriate age groups, and Hellman is responsible for the commonly accepted method of making this type of division.

Once one has divided his material, the next step is to arrive at a picture of the norm for each particular age; and, having arrived at a series of norms of ages, one treats the resulting data as though he were dealing with the same continuing individual. Actually, he is dealing with a great many different individuals.

There was great need of a method that would permit the taking of accurate measurements directly from the same living individuals throughout the growth period. In 1930 that tool was placed in the hands of scientists by Dr. B. Holly Broadbent of Cleveland, a member of your College and of my Association. Broadbent’s accurate roentgenographic cephalometer permits placing the individual in a head-holding device in a position that can be duplicated at any subsequent time throughout his life so that the X-rays that are taken will be exactly comparable in size and position.

When I think of Broadbent’s work I think of another of his contributions that has rarely, if ever, been equalled. This is in the field of public relations. His enthusiasm and his convictions have enabled him to interest the mothers of Cleveland children to such an extent that they have brought their children back to the laboratories in order that they may be X-rayed at least annually.
over periods beginning at three months of life and extending through fifteen to eighteen years. As a result, there is today at Western Reserve the greatest collection of longitudinal records extant in the world, and all due to this one man.

But even X-rays have shortcomings. The X-ray will tell in what direction growth is taking place, and how much growth is taking place. It is inscrutable concerning where growth is taking place. Therefore, it was necessary to refine some of the previous methods, particularly that of vital staining, and to study patterns of animals that could be sacrificed, but animals whose patterns were closer to the pattern of man than were those that had been used previously. The monkey, of course, is ideal. The pig, as you probably know, will eat anything, and so it is no job to feed a pig a mess of madder soaked in bran. The chicken is not much more finicky than the pig, so the feeding of the fowl is not much of a problem; but a monkey is a very exacting connoisseur of what he puts in his mouth. All efforts to feed these animals madder, even to the extent of tempting them with injected bananas, failed. It was therefore necessary to find a more exact and assured method of getting the dye into a living animal. For this we are indebted to another member of the dental profession, Dr. Schour, and his co-workers, who ultimately worked out the technic for injecting animals with one of the derivatives of madder, namely, Alizarine Red S.

From the wedding of these two methods, it is now known pretty accurately where bones grow, particularly the bones of the head and the face. From X-ray cephalometry the results and the magnitudes of this growth are known. All of these major contributions, as I have said, have been made by members of the dental profession.

Dr. Schour: Dr. Brodie, given these methods that have been evolved, what have been some of the most significant findings derived from them; also, have some of these findings been applicable to clinical procedures?

Dr. Brodie: Well, as might be expected, certain things that had been anticipated have been verified. For instance, it has been shown quite conclusively that the human head grows just the same as an animal head, and in the same places or sites. Apparently the differences that bring about species determination are matters of relative growth rates in different places. The pig, a long-snouted animal, gets much more growth between certain of his bones than does the human being. The human face, being vertical in its orientation, gets a great deal more at other sites.

When it came to the amount of growth, however, there were some surprises. It had been taught, on the basis of skull measurement alone, that the skull cavity grows by deposition of bone on the outside of the skull and absorption on the inside, the two processes taking place concomitantly and maintaining the balance.

The staining of the monkey revealed, however, that after a rather early age, when the edges of the bones are once approximated, practically all growth in the
enlargement of the brain case takes place at the sutures. The bones, one might say, are pulled apart by growth, and apparently in an effort to keep the brain in contact with the brain case, the latter is thickened by deposition on its internal surface. In the case of the face, vital staining as well as cephalometry has shown that there is a general growth of all bones up to the fourth or fifth year. After this, the generalized type of growth ceases, and then all growth seems to occur at sutures and at such cartilaginous sites as those between the sphenoid and the occipital and at the mandibular condyle.

The result of all of this growth, however, is so closely integrated, is so harmonious, that the pattern that is laid down long before birth never changes. It remains the same in proportions, in ratios, in angular relations, from birth through life.

As far as the specific growth of the face is concerned, it has been shown that the maxilla grows on practically all of its superior and posterior surfaces against relatively fixed cranial bases, so that there results a pushing downward and forward movement of the entire facial mass away from the brain case. The mandible, as has been known since the days of Hunter, grows similarly in an upward and backward manner. All of this growth, as I have said, is so beautifully integrated that no change in relationship takes place. There is one independent addition, of course—the growth of the alveolar process, which does not occur unless teeth are present.

The application of some of these findings to clinical dentistry has led to some important changes in concepts. One of the most valuable from a clinical standpoint, I believe, was finding that the relation of the mandible to the rest of the head and face is assumed before birth, long before any teeth come into the picture, and is maintained throughout the entire period of dentition and after the teeth are lost. In other words, the mandible has a fixed position in relation to the rest of the head, and is not dependent on teeth.

There is always an interval between the upper and the lower teeth; there is always an interval between the jaws before the teeth erupt; there is always an interval after the teeth are lost. This has given to the man in prosthetics and crown and bridge, or to anyone interested in restorative dentistry, a starting point upon which all operations can be based.

It has been shown, for example, that if this position is disturbed in so-called bite-raising operations and the mandible is depressed to a level below that dictated by the muscular balance that controls the bone, the mandible will return to its original resting position within the period of one year, even if it has to destroy the alveolar process to do so.

This work has shown the orthodontists the limitations of their efforts. It has shown them that they frequently disturb relationships, but it has added salve to the wound by showing that most of those disturbances recover themselves as time goes on. It has shown the orthodontist further that the striking
changes that are produced in some treatments for malocclusion are largely the result of guiding growth rather than of the manipulation of appliances. Then, of course, there has been the general improvement in diagnosis, prognosis, and methods of treatment.

One of the most striking applications of the work at the present time is to the field of oral and maxillofacial surgery, and particularly in the handling of congenital anomalies, such as cleft palate and harelip. Long-range or longitudinal investigations have shown that the congenital anomaly grows at the same rate and grows just as well as the normal grows. It is as though the blueprint were distorted but the bricks were laid on at the same rate.

The oral and maxillofacial surgeon has been given a yardstick to measure the effect of his interventions. He has found in numerous cases that his surgery acts as an inhibiting factor in areas that should grow normally, and would grow normally if surgery were not employed, and he has found in many other cases that surgery should be withheld until growth has been completed.

Dr. Schour: So far we have considered the problems of oral infection, dental decay and growth. We might as well now consider the problems of transferring that knowledge and increasing the knowledge we have by the so-called education method and education research. At this time we might well proceed with several points of discussion for Dr. Blauch.

Dr. Blauch, how have research methods come to be applied to education?

Dr. Blauch: Dr. Schour, that would be a long story if one were to narrate it in detail. In general it can be said that research methods came to be applied to education many years ago, but the really significant developments began some time soon after 1900. One of the very earliest of the studies was made by a Frenchman named Binet, and out of that came the famous Binet tests about 1905 which were used for detecting feeblemindedness in children. That was perhaps the first outstanding landmark.

We soon began to have studies to determine how much children learned and how much they were able to learn. We developed tests of all kinds related to these problems. In a very short time the same type of objective study came to be applied to all phases of education, administrative as well as instructional. The result has been little short of revolutionary in educational practice.

As early as 1910 or thereabouts we began to have a new development known as the survey, when school systems called in specialists to study particular problems which those systems had, or, in some cases, to give an evaluation of the whole system which could be used as a basis for outlining and administering new educational policies and plans.

The survey idea came into professional education about the same time. In 1910, the Carnegie Foundation for the Advancement of Teaching published a study of medical education—a study which was made by Abraham Flexner. The results of that work were immediate and pronounced. In a very short time
the same Foundation undertook another series of studies in engineering education, in legal education, and, finally, in dentistry. Very soon thereafter, professions began to make studies of this type for themselves; that is, they themselves undertook them instead of having some outside agency do it. The result has been that today in practically every profession that has got out of swaddling clothes one or more extensive studies have been made of its functions, its services, and the best way in which it can carry on its work.

So, this development has come to us since about 1910; the same types of scientific procedure which have been so well applied to the study of all sorts of questions in science, are also being applied in the study of education. We have therefore a goodly body of scientific technics, methodology and scientific findings with respect to how the educational process goes on and to how that process can best be carried on administratively.

DR. SCHOUR: Dr. Blauch, more specifically in relation to dental education, what associational and cooperative research has been done in dentistry?

DR. BLAUCH: There are four studies that fall into this category which may be summarized very briefly.

In 1911, I believe, the Dental Faculties Association of American Universities, seeing the tremendous value of the study which Dr. Flexner had carried on in medical education, approached the Carnegie Foundation for the Advancement of Teaching to make a study of dental education. The Foundation hesitated for some time but, finally, in the 1920s, undertook such a study, and engaged the services of Dr. William J. Gies to carry it on. That study, which ran from 1922 to 1926, is, of course, one of the great landmarks in dentistry and dental education.

The second of these studies was the curriculum survey carried on by the American Association of Dental Schools from 1931 to 1935. That study, which was supported by the Carnegie Corporation of New York, was an attempt not so much to evaluate the current practices, as to explore the problems of the dental curriculum and to present a guide for dental schools and dental teachers. There is reason to believe that this study has had a very stimulating influence. In fact, a very recent report by the Russell Sage Foundation found the project so suggestive for ambitious undertakings in research planning and methodology that it described the work in considerable detail.

The third of these associational and cooperative studies was, of course, the survey made by the Council on Dental Education from 1942 to 1943. During these years all dental schools were visited by representatives of the Council. They were carefully studied, and as a result there was published a few years later a list of accredited dental schools in the United States.

Another outcome was a very admirable book by Dr. Homer, entitled Dental Education Today. This stands now as the authoritative, up-to-date, and comprehensive source of knowledge concerning dental education in America, a com-
plete and accurate report which everyone interested in dental education must read.

The fourth of these studies to which we should refer is the testing program now being carried on under the direction of the Council on Dental Education and Dr. Peterson. This project is second to none in its field. It surely will have a tremendous impact upon dental education.

What of the future? There are those who think that the time has come for another comprehensive study of the educational program in dentistry. No doubt some of you know that Dr. O'Rourke had prepared a blueprint for such a study. Let us hope that someone or some group will be found who will be able to go through with a new study, for certainly many new conditions have arisen in the past fifteen or twenty years, some of them within the schools, some of them in the fields of science and technology, and some of them in the social and economic relationships of the profession. Certainly a new evaluation and a chart pointing the direction of the future would be tremendously helpful.

I may say, incidentally, that a different problem confronts the dental examiners. They have for a number of years been trying to make a study that would evaluate their procedures. They are in the process now of doing something by way of developing an annual seminar for examiners that I am sure is very promising.

Those, then, are the four studies which can be placed in the category of associational and cooperative studies. I hope the time is not too far away when another rather comprehensive study of dental education can be made.

DR. SCHOUR: Dr. Blauch, in addition to these cooperative studies, has any institutional research been done in the field of dental education?

DR. BLAUCH: Yes, Dr. Schour, there has been some in this field, but not nearly as much as one might hope for. I recently turned the pages of the Journal of Dental Education to determine what research articles on problems in dental education one might find. This is by no means a complete list. I must say that certainly some research reports in dental education have been published elsewhere, and undoubtedly some schools have made studies which have not been reported. Here are some samples from the Journal of Dental Education:

First, “Color Discrimination and Color-Blindness Among Dental Students”.

Second, “A Comparative Study of 1937-38 Dental Curriculums”.

Third, “A Survey of the Financial Status of the University of Minnesota Dental Students”.

Fourth, “Motion and Time Study in Dental Education”.

Fifth, “A Survey of the Use and Teaching of Dental Technicians in Dental School”.

Sixth, “Prediction Value of Grades in Various Types of Predental Courses”.

Those are samples, and they represent what one would call scientific or objective studies. Of course, the Journal of Dental Education has many other very
useful articles, but most of them do not belong in the category of which we are speaking here. I must say, however, that there are not nearly as many of these studies as one might wish for. This is, then, a field which needs cultivation. Dental schools should attack their educational problems in exactly the same way, by the same methods and scientific procedures, that they use in studying any kind of scientific problem, and certainly it is not too much to expect the dental faculties to organize themselves to attack these problems in exactly the same scientific fashion.

This can be done through a regular committee organization; it can be done by faculties, by individual faculty members carrying on particular studies of their own; but certainly there is a very great need to attack these educational problems in some such fashion as I am referring to.

After the job is once done, after a study is once made, it should by all means be published so that other schools and other persons interested in the field will have the benefit of that work.

DR. SCHOUR: So far we have heard some of the challenges to the researcher, the teacher and the clinician. The next point is the welfare and health of the public. I think that for this reason we may well go on to an observation of points which Dr. Knutson will discuss. Dr. Knutson, before you present your remarks on present dental activities in the field of public health, will you please discuss briefly the place of dentistry in a public health program?

DR. KNUTSON: Generically, public health refers to the health of groups of individuals or of individuals in the aggregate, such as the people of a community, a state or a nation; and recently we have even ventured to think of world health.

When a specific hazard to health is of such a nature or extent that it requires organized community effort for its effective prevention or control, then that effort involves what have become established as the science and the art of public health administration. In an over-all sense, application of the body of special knowledges and skills concerned with the prevention and control of hazards to dental health involves public health administration. The most common and the most prevalent of all diseases in this country is dental caries. Surely if the extent of the problem is one of the criteria for determining whether a disease or hazard to health is a public health problem, then dental caries is one.

I referred to the science and the art of public health administration. This is not an occasion to speak of art, but it is an occasion to speak of science; and public health administration is based on several scientific disciplines or special categories of science.

If organized community effort is to be directed effectively toward preventing a disease, then the problem must be accurately delineated or diagnosed on a community basis. The characteristics of the disease must be studied and evaluated
scientifically. To do this we utilize the scientific tools which have been categorized under the term "epidemiology." Through the application of epidemiological methods we obtain a picture of the occurrence of the disease, its distribution and types, and the relations of these characteristics to the individual and to the conditions surrounding him. Such studies naturally involve factors which are affected by a multiplicity of causes and, therefore, involve the use of mathematical sciences of a special character which have been classed under the heading of "Biostatistics."

Microorganisms, or bacteria, are common to many of our disease hazards. Tracking down the specialized skills, habits and reactions of such bacteria, as manifested in population groups, and the development of appropriate countermeasures are accomplished by the application of bacteriological and immunological sciences.

The matter of working with groups of individuals involves other scientific disciplines, such as those of psychology and of education. However, these and administration itself involve not only science but art; at least, their effective application appears to involve mixtures of art with science.

I believe this preliminary statement has indicated dentistry's place in the public health program and the scientific disciplines employed in public health administration. Further, and more specifically, it is intended to point up the fact that the basic purposes of expending scientific effort in each of the fields being discussed in this symposium—oral diagnosis, dental caries, facial development, dental education and research, dental research in biological sciences, dental research in physical sciences, and dental technology—are in the interest of public health.

DR. SCHOUR: You have referred to public health and bacteriology and immunology, and even environmental sanitation. Tell us how these are being employed in present dental public health activities or programs.

DR. KNUTSON: First, it must be recognized that in this country dental public health activities are still in their infancy. Although the number of states with organized provisions for administering dental programs on a state-wide basis has increased from thirteen in 1935 to forty-four in 1948, these provisions are largely of a skeletal nature.

The activities of these programs are heavily weighted on the educational side. There are exceptions; there are wide variations. In order to make the benefits of the dental health sciences available to more people, some state dental health programs provide care for those who cannot afford to pay for needed health services. Others, through school and industrial programs, promote attention to dental health and encourage the seeking of regular dental care. Some, through mobile dental units, provide services in areas where there are no established facilities for dental care. Some concentrate their time and attention
towards increasing the quantity and quality of services available to children by providing special postgraduate courses in dentistry for children.

Recent activities which are just now getting under way include effort directed toward controlling oral cancer through provisions for training dentists in the early recognition of this disease; the establishment of standards for dental departments in hospitals; and the promotion of adequate organization and facilities for setting up such departments in newly constructed hospitals.

Perhaps the most recent activity is the provision of the Federal government for the establishment of a topical fluoride demonstration unit in each state. The purpose of this program is to demonstrate the technic of application to dentists and dental hygienists in private practice, to provide a training base for dentists and dental hygienists employed by local and state health departments, and to furnish examples of the manner in which a topical fluoride program might operate on a community basis. These demonstrations are a device or mechanism for promoting the establishment of continuing topical fluoride programs on a local level. They are not in themselves fixed or permanent programs.

DR. SCHOUR: There is evidently a very rich scope of activity that is well established. What about the future?

DR. KNUTSON: As I visualize the future of dental public health, the scientific disciplines of public health administration will be effectively applied on community-wide, state-wide and nation-wide bases. Most important of these is the community. If this is done an ever-current knowledge of the problems in each community will be the basis for the program of operations.

Dental care of the highest quality will be available and accessible to all. Preventive procedures will be applied effectively and completely as soon as their worth has been established. Research will be a vital part of as well as a base for all dental health activities. Not only will there be expanded and more productive research in the basic sciences, but much more effort will be directed toward uncovering new and better methods of prevention. Work leading to the discovery of new and better methods of treatment will be fostered and supported, and an appropriate number of the applied sciences will be concerned with the development of more effective methods for making necessary dental health services available to all.

In visualizing this state, I want to emphasize that dental health services of the highest quality have been specified. If our goal is to include such services, then it seems to me imperative that the members of the dental profession responsible for rendering these services must participate on a basis which encourages effort under an even more attractive working environment and with broader horizons of opportunity than obtain today.

This new day of dentistry in public health must of necessity be preceded by a
marked change in the place of the disciplines of public health in the curricula of
dental schools. That change will not be foreshadowed by the addition to the
academic requirements of what appear to be appropriate courses. Rather it
will be marked by a change in basic philosophy and a recognition of the relation
of applied health sciences not only to individual health but to community health
and to the over-all health status of the nation.

DR. SCHOUR: Dr. Knutson pointed out that further advances in public
health naturally will depend in part upon further research, so let us go back to
several fields of research and consider the particular aspects. Dr. Kitchin, what
are some of the outstanding past biologic researches in the field of dentistry?

DR. KITCHIN: We are attempting a rather ambitious project, I think, when
we even try to consider all the men who have contributed to this field. I feel
nonplused when we speak about the absence of biologic research in the early
history of the dental profession.

We can start with Wells and Morton and their immortal contributions to the
relief of pain. We certainly have to remember that G. V. Black, who worked so
admirably with physical materials, was also an outstanding contributor to
biological research, along with Williams and Goadby. We are much impressed,
in these days, with the early work of McKay and Black on the endemic aspects
of mottled enamel. These pioneers covered the Pike's Peak area in a horse
and buggy and gathered data in the hard way by knocking on doors and
questioning the entire population concerned.

The work of Hunter already has been mentioned as a foundation for some of
the present activities in the studies of the development and growth of the head
and face.

Any consideration of the structure of the enamel and dentin would be quite
incomplete without the contributions of that earnest scientist, Theodore Beust.

Recently we have been saddened by the death of one of the men who made a
great impression from the biologic research standpoint, whether you agree with
his findings or not; I refer to Weston A. Price.

I make no attempt to be chronological, and I expect that we could go on for a
considerable length of time speaking of the biological contributions of the past
which have been of great import and will continue to be so in the future. In
some cases these contributions were neglected for years. I have often thought
that W. D. Miller was many years ahead of his time. It would appear that way
from the fact that it took about thirty years for his work on oral acidogenic
bacteria to be resumed by the Michigan group and later to be taken up by
others.

Let us think for a moment about a quiet and unassuming young man who did
perhaps more than any other one person to turn our attention to the biological
phases of dentistry: Rudolf Kronfeld. Milo Hellman, who has but recently
passed from the scene, made impressive contributions from the biological standpoint. We could also mention a number of living individuals who have contributed to the biology of dentistry. Among these are Balint Orban, Trendley Dean and Russell Bunting. We could make some reference to the contributions of Gottlieb, especially his earlier work. Realizing that we slight many who should be included, we stop here. I do want to emphasize again that there has been much biologic research done in the past. Perhaps, it has been dwarfed by the pressing need for more.

DR. SCHOUR: Dr. Kitchin, we appreciate the fact that you have outlined the history of biologic research and naturally considered the individuals; but we know that while research can be done only by particular individuals, they can do more or less depending upon how much encouragement and help they may obtain. In this connection, what has been the contribution of the American College of Dentists in encouraging research?

DR. KITCHIN: I have always been proud of the contribution that the American College of Dentists has made. It has not been a great contribution financially, but it was made at a time when there was practically no other source of financial aid for research workers in the dental field.

In 1940, when the Committee on Research was instituted, it started in a very small way. In the period from 1940 to the present there have been twenty-one grants-in-aid made for research by the American College of Dentists.

As I said before, it has not been a large financial contribution, but it came at a critical period. There has been a total of about $11,500 spent, but I think the American College can well be proud of the fact that this small investment already has resulted in twenty-seven published articles. Incidentally, although big foundations expect to spend about $2,500 to secure one published article, the average is about $340 for grants from the American College.

Some of the early work of Armstrong and Knutson on topical fluorides was helped by A. C. D. funds, and investigations by Hunt and Hoppert on inheritance of rat caries have been largely supported from this source to date.

DR. SCHOUR: Because of the fact that you are Chairman of the Dental Study Section of the United States Public Health Service, will you please tell us what it has been doing and what it is trying to do in the field of dental research?

DR. KITCHIN: Up to three or four years ago, if anyone had asked me what was being done to aid dental research, outside of the American College of Dentists, I would have had to say that there was practically nothing. Dentistry has raised itself by its own bootstraps, figuratively speaking, from the standpoint of financing research.

The United States Public Health Service in 1946 established twenty-one study sections with the avowed intention of giving grants-in-aid to various individuals and institutions that needed such aid for the carrying on of research projects.
Among these twenty-one sections was one of the really big things that have happened in Dentistry recently, the Dental Study Section of the U.S.P.H.S. In the course of the two years in which this Study Section has functioned, six projects have been aided financially—and again I don’t want to dwell upon the amounts because they are not in the millions. Suffice it to say that $300,000 has been given to various investigators to work upon research projects in dentistry.

I should also state that there have been applications for grants which were not given. This Dental Study Section, instead of merely spending Public Health Service Funds, was interested in seeing that what funds were granted would at least have some prospect of producing results of value to dentistry and public health.

The sum requested for research grants for 1950, on the basis of what we have been able to do in the past, will total about $500,000. We consider that this amount can be well utilized.

You might be interested in the askings for the several successive future years. For 1951, we believe on the basis of past experience that about $700,000 could be profitably used. In 1952, we expect the amount to be increased to $850,000 or $900,000; and in 1954, the probable budget will amount to about $1,100,000.

DR. SCHOUR: You might say, Dr. Kitchin, that sums are also available for fellowships which, of course, are quite important; because, as we discussed previously, research is done by people who first of all are trained in research, and these grants have been materially given in promoting the training of young men in dental research.

Up to recent times, when we thought of dental research, we naturally were prejudiced in favor of biologic research; but times have changed, and now we are recognizing that the physical sciences are going to play an increasing role and will make an increasing growth, not at the expense of the biologic sciences but in addition to them. Therefore, I think, it would be worth while to turn our attention to the field of physical science.

DR. SCHOUR: Dr. Bibby, in this atomic era one naturally thinks of the electrons, cyclotrons, and so on, when the physical sciences are mentioned. Let’s jump right in, therefore, with the question: Has the atomic bomb affected dental research?

DR. BIBBY: That might be designated a very startling question. The answer is yes. The atomic bomb, as symbolic of the development of the growth of atomic physics, the Manhattan Project and now the Atomic Energy Commission, has affected dental research. The effect has not been so much a question of beginning dental research in that area but rather a matter of facilitating it. Actually the first biological work done with radioactive isotopes, which is the application of the products of nuclear fission to research, included
studies of the passage of radioactive phosphorus to teeth and bones. So dentistry was among the first fields to utilize these remarkable new research instruments, the radioactive isotopes, in trying to solve its problems.

The interesting thing about the atomic bomb, to get back to your question, is that as a result of the work done on it—the development of the atomic pile, for instance—the production of radioactive isotopes has become much easier, much cheaper, and there are now available much larger supplies. The Atomic Energy Commission is making available to research workers at very reasonable rates, a great variety of isotopes, and is distributing information regarding the isotopes which are available. Further the A.E.C. is disseminating information on methods of fluoride analysis and on other subjects which have a direct bearing on dental research. The pamphlet in my hand is a list of A.E.C. publications, some of which are of interest to dental investigators. In short, the atomic bomb has opened up opportunities for dentists to utilize the most modern research tool—radioactive isotopes—in a much larger and efficient way than ever before.

DR. SCHOUR: So far, Dr. Bibby, your discussion, while dealing with the use of a physiochemical tool, has been largely in the biological sciences. Are there other areas in which physical sciences are being used in dental research?

DR. BIBBY: Yes. When I accepted this assignment to discuss the physical sciences in relation to dental research, I did so with a distinct understanding of my limitations in the field. First I asked myself, What are the physical sciences? Before telling you what I decided, I might add that one reason why I accepted this assignment is that I know that the best way to improve one's knowledge of a subject is to teach it or talk about it. It may become obvious to you that this has been part of my motivation in accepting this assignment.

To me the physical sciences embrace basically physics and chemistry, including the intermediate territory known as physical chemistry.

In physics are included heat, light, sound, electricity, mechanics, and, of course, atomic physics.

Physical chemistry deals with the borderline between physics and chemistry; chemistry we don't need to explain. I think that in all these areas we could find points at which research in the physical sciences is coming to have some bearing on dentistry.

DR. SCHOUR: Will you give some examples of how these subdivisions of physics, and so on, are being used?

DR. BIBBY: On atomic energy or atomic physics we don't need any more discussion. The use of radioactive isotopes in the study of tooth metabolism has already been mentioned. In this division of physics there is definitely a relationship to dental research.

Heat is now regarded as a very prosaic subject. In this connection the point
might be made that one of the disadvantages of any startling finding in any field of research, be it nuclear fission in the physics field or fluorine therapy in the dental field, is that the new finding tends to distract attention from the older fields of study. I think that has been particularly true in physics, and subjects like heat and mechanics have suffered.

There is a distinct possibility that studies in the field of heat will influence dental procedures. Work is going on, as you know, on the conduction of heat in the teeth and the development of cooling procedures in dental operations to reduce pain and protect the dental pulp.

At the present time there scarcely exists (and the fact is rather strange) any good method for measuring color. I know of at least one man in the dental field who is investigating color-measuring instruments; he has developed one which is being applied by industry, because industry could not find better instruments elsewhere for measuring color. His thought was to develop an instrument which would enable him to determine changes in tooth coloration with age, or to match teeth for denture purposes, and so on.

We are hearing a great deal about ultrasonics in these days of jet planes when wave frequencies or sound variations beyond the perception of the human ear have become very important. I know of at least one dental man and of two research groups in this country who have been investigating tools which vibrate at a frequency greater than the frequency of sound, for use in cutting operations in the mouth. I have actually seen gold fillings put in by ultrasonic tools. Theoretically such tools will deliver power without the noise of the burr, and there are certain other possible advantages in their use.

In the field of electricity we come immediately to the x-ray as a method of determining the structure of the tooth. I don’t think dentists realize that their field of work is perhaps better understood from the standpoint of the basic molecular structure than any other part of the body. That is because of the application of x-ray diffraction to the study of the molecular structure of the enamel and dentine.

It might be worth noting that knowledge of this molecular structure of the tooth enabled sound theories to be made in respect to the action of fluoride on teeth. It definitely speeded up the development of a practical method of caries control by means of topical fluoride application.

Another application of the physical science of electricity scarcely needs mention. We have seen numerous illustrations recently of dental structures illuminated or, rather, delineated by the electron microscope. The work at the National Institute of Health, by Scott and Wycoff, is particularly noteworthy. I am glad to say that in this field, as in practically all the fields I have mentioned, the dentists are pulling their weight and are making their full measure of contribution to basic knowledge and methodology.
The last division of physics is mechanics. That is perhaps the oldest but the most deserted or least-favored field in the whole area of physics. Here we have studies on the hardness of the teeth. Here we can note that the hardness of the tooth is being correlated with its resistance to acid and with the effects of various chemotherapeutic agents on caries resistance.

Other interesting work was mentioned in a recent editorial of the *Journal of the American Dental Association* (37: 351, 1948): Dr. Manly’s work in developing instruments for measuring the biting stresses and the other pressures in the mouth. He has been able, stimulated as he was by the interest of the late Dr. John O’Rourke, to demonstrate that the movements of the teeth, including the masticatory movements, are somewhat different from what we believed. He has also demonstrated various interesting phenomena concerning the sensitivity of the teeth to pressure stresses, and so on. Manly’s latest development is a little gadget which should make it possible to determine the actual extent of lip pressures, and so on, on individual teeth. This medium might well have an important bearing on orthodontics and on partial denture prosthesis.

In all of these fields you can see applications of the physical sciences that have a direct bearing on dentistry. I do not want to talk too long, but I would like to discuss physical chemistry because it comes closest to the field in which I am particularly interested—topical fluoride therapy. What makes this therapeutic procedure effective? It is apparently some physiochemical reaction at the tooth surface. Several papers have been devoted to trying to explain what happens. I am not satisfied that any of them has produced the answer. There are a great many possibilities which could yet be developed. I think much further progress can be made in determining the type of surface reactions that occur, and in increasing their effects in relation not only to fluoride therapy, but also to such matters as the passage of anesthetics through the tissues. These are problems in physical chemistry.

**DR. SCHOUR:** Thank you, Dr. Bibby. It is apparent that if by any stretch of the imagination some of the dentists of 1840 could listen in on this discussion they would have a very difficult time. I imagine they would say, “Let’s get hold of a dictionary and see what they are talking about.” That wouldn’t help because there was no dictionary in 1840 that would include even 10 per cent of the terms we have used here. I think, therefore, we can say that dentistry is reaching maturity. There seem to be some fields of science that have simply been touched upon, a fact that causes one to wonder whether we can say that we have matured or rather that we are going through a very active period of adolescence.

In this period of spurts and activities, we naturally do not want to forget one of the most important problems of dentistry: dental technology. We are
fully appreciative of the importance of biology and of the importance of the interdependence of the oral cavity with the rest of the body. We also appreciate the responsibility we have in correcting those defects which science has not yet been able to prevent. Therefore, we are going to close our discussion with a number of questions addressed to Dr. Wright.

Dr. Wright, what is the relation of medical technology to the practice of dentistry?

DR. WRIGHT: Dentistry in America began as a surgico-technical art and practice, and was established and recognized as a separate division of the healing arts long before the first dental college was founded in 1840.

A review of the history shows that dentistry, through the centuries, has been distinguished from medicine by its peculiar type of treatment which involves a wide variety of technical skills, without which the profession could not have developed.

Certainly, there is more to dentistry than technic, but the non-technical aspects of dentistry are not so obvious, although important in health-promoting dental service. This interrelation of technology and the biologic sciences is so important that without its technical nature dentistry would be medicine; while, lacking a biologic background, it would be a trade.

From its early days, dentistry has continued to develop its technical arts; at the same time it has expanded its horizon to include the biologic sciences, which form the directing influence in dental practice.

At present, good dentistry has the respect and endorsement of all fair-minded people. Dentists generally are held in esteem by those who have benefited from their services. This respect stems from the fact that the dentist is able to place fillings; make crowns, bridges, and dentures; extract teeth; locate foci of infection; prevent oral diseases; and administer many other health-promoting services which are made possible by his unusual technical skill.

In reality, dentistry survives because it consists of a variety of related technical processes and skills so integrated with biologic and mechanical sciences that the members of the dental profession are able to provide a peculiar oral health service which no other group is qualified to render.

DR. SCHOUR: What may we expect in the field of dental technology as a result of the current and future research in preventive dentistry?

DR. WRIGHT: The result of a single research project may change the character of a specialty and determine the fate of a profession. Recent discoveries in the field of antibiotics have greatly modified the practice of specialists in the field of otolaryngology. The use of such treatments has brought diseases of the nose and throat under such control as to compel specialists in this field to seek employment in the field of plastic surgery. I do not want to be an alarmist, but the dental profession should know that some of these medical specialists are transferring to the field of oral and plastic surgery.
As we think of dentistry's future, we must try to envision what changes may result from research leading to prevention, or control, of dental diseases. Undoubtedly dental caries will be brought under partial or complete control among those groups receiving preventive treatment. This will reduce the need for operative dentistry and increase the need for personnel in the field of preventive dentistry.

Preventive procedures, however, are only one side of the problem. Are we going to raise up a new generation with sound teeth only to have them lose these teeth by ever-increasing diseases of the tooth-supporting tissues? It appears that the control of dental caries may be a relatively simple problem as compared with the control of periodontal diseases, which appear to be increasing.

My guess is that the technical phases of dentistry must be increased in the area of prosthetic dentistry in order to meet the increasing demand for prosthesis. I view this restorative service as being more closely related to the preservation of the health of remaining teeth and their supporting tissues than it has been in the past. This concept would favor a more comprehensive knowledge and understanding of the biologic sciences in prosthetic service, which would elevate the quality of restorative service and increase respect for it as an oral service to be properly taught in dental schools and adequately rendered in practice.

Dentistry has not developed and probably will never develop to the point where technology can be greatly reduced or eliminated from dental practice.

DR. SCHOUR: Is it possible that dental technology may be delegated to adjuncts of the dental profession?

DR. WRIGHT: Yes, it is possible. But if dentistry is awake it will supervise the training of such adjuncts and employ them under full professional control. Only by such conditions of training and employment would it be possible for the profession to control its adjuncts and assure the highest quality of oral health service to the public.

As the demand for dentistry increases, it will be impossible to supply enough dentists to care for the public unless these dentists are assisted by properly trained and professionally related adjuncts: dental assistants, nurses, hygienists and technicians.

The preventive field will no doubt use more dental assistants, nurses and hygienists, who should be equipped with a professional background. They should aid the dental profession instead of trying to separate from it in order to practice by themselves, as is now being agitated among a group of hygienists.

At the moment the dental profession employs the services of commercial dental laboratories in rendering prosthetic dental service to the public. This service is frequently below the standard which a dentist who employs a technician in his own office can provide. Some dental schools are now offering
courses for dental technicians. This development will assure qualified technicians, but it will not assure their employment by the dental profession. It is evident that such technicians, if not employed by the profession, will drift into commercial dental laboratories, or set up their own laboratories. Under these circumstances a certificate issued by a school of dentistry may be used to advantage if and when social changes should alter the present profession-public relationship.

I envision a continuing need for the technology in dentistry. I regard it as a fundamental necessity in the practice of dentistry. I feel that certain phases may be delegated to adjuncts under professional control, but they must not be appropriated and removed from the profession by such adjuncts. The oral cavity is entirely too small a field to accommodate the dental profession and a sub-dentist group of adjuncts. If dentistry is to survive it must retain control of all those technical processes and practices which have made and will keep it an autonomous profession.

Dr. Schour: At this point I am in a dilemma because we have a conflict in time. The program calls for an open forum, but the program also calls for adjournment at noon. It is now ten minutes of twelve. I would like to ask Dr. Main to resolve this situation.

President Main: I wish it were possible to continue with this discussion, because it is helpful and interesting to all of us and it may have a very decided effect on the destiny of our profession.

On behalf of the College I want to thank you, Dr. Schour, and those who have participated in this panel. We appreciate your contributions very much indeed. The quality of your efforts indicates much time in preparation given by busy men in order to make this session a success.
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