Ackart, Everett

1943 - 1944

November 5, 1943

Mr. Everett G. Ackart
"Rockmere"
Barley Mill Road
Wilmington, Delaware

Dear Mr. Ackart:

We greatly appreciate your letter and also the enclosure of $100.00 for the needs of West China Union University.

We wish that all the friends of Dr. Beech could be with us in Toronto, as from all appearances he has a host of friends in America. This can, of course, be multiplied many times in China.

With many, many thanks, I am

Very sincerely yours,

C. A. EVANS

CAE/B
ENC. (Receipt)

(Dictated November 2, 1943)

E. G. ACKART
NEMOURS BUILDING
WILMINGTON, DELAWARE

February 14, 1944.

Mr. C. A. Evans, Asst. Treas.,
Board of Governors
West China Union University
150 - Fifth Avenue
New York City, N.Y.

My dear Mr. Evans:

When I wrote you on October 16, 1943 in connection with Dr. Jos. Beech, I believe I mentioned that the Dean of Women at West China Union University was a first cousin of mine who went to China some 25 years ago, having gone first as a Y.W.C.A. secretary. I am under the impression that she is working (at W.C.U.U. on the Women's college staff) under the auspices of the Church of England or some association connected with it.

We nor her brothers in America have received any word from her for about two years, and I sent her address to a young friend of mine who has been in the American Air Service in India for nearly two years, hoping that sometime he might be in Cheng Tu. He did have occasion to remain for a day or two in Cheng Tu about three weeks ago and called on Miss Mary E. Streeter, our cousin, at her little home on the edge of the campus, and in a letter to his mother which was read to us on January 29, the boy reported that Miss Streeter was in good health and enduring the hardships of the concentration of an unusual population in Cheng Tu, and also was suffering considerably from inflation.

In a letter received a couple of days ago from Dr. Joseph Beech, to whom I had written to find out how we might perhaps get some funds to Miss Streeter, he suggested that I write to you asking if it would be possible for you to include a sum for Miss Streeter in your next draft to your W.C.U.U. field treasurer, or if you might be able to authorize the field treasurer to draw on you as New York Assistant Treasurer, the amount that we would wish to send to Miss Streeter, a member of the W.C.U.U. Women's college staff.

I understand that the inflation is quite extreme, with a black market of about $100 to $1 U.S.; that regular missionary agencies get a special rate of $40 to $1 U.S. which helps but by no means equalizes the present with former cost of living.

I would appreciate any advice you could give me, Mr. Evans.

Sincerely yours,

Ackart

EGA S

February 25, 1944

Mr. E. G. Ackart
Nemours Building
Wilmington, Delaware

Dear Mr. Ackart:

I have delayed answering your letter of February 14th until after I could have a conference with at least one of our staff members who has just returned from West China. I wanted to check on the financial situation and ascertain the exact attitude toward the things which you are requesting me to do. Dr. Beech knows that we have done something of this in the past for a few of our friends and was quite right in suggesting that you write to us.

My reaction now is, that it will be possible for us to send such amount as you may desire which will in time be transmitted with our other monthly drafts to our Treasurer in China, who will be instructed to give this to Miss Mary E. Streeter. You are correct in assuming that the present rate of exchange is practically 40 to 1.

Very truly yours,

CAE:EW.

C. A. EVANS

E. G. ACKART
NEMOURS BUILDING
WILMINGTON, DELAWARE

March 1, 1944

ack 3/2/44

Mr. C. A. Evans
Associated Boards for
Christian Colleges in China
150 Fifth Avenue
New York, N.Y.

My dear Mr. Evans:

Appreciating the difficulty of getting communications through to Cheng Tu, I am asking if you can forward the inclosed personal letter which I have written to Miss Streeter, through channels of which you know, to insure its delivery to her. I am inclosing the letter in an envelope unsealed so that it might be censored in your office before you take the responsibility for forwarding it. I am inclosing postage stamps to be used in any way necessary for the forwarding of this letter.

Thanking you very kindly for your courtesy and help, I am

Very truly yours,

EGA S

Inclosure

E. G. ACKART
NEMOURS BUILDING
WILMINGTON, DELAWARE

March 1, 1944

ack 3/3/44

Mr. C. A. Evans
Associated Boards for
Christian Colleges in China
150 Fifth Avenue
New York, N.Y.

My dear Mr. Evans:

In accord with my understanding of your letter of February 25, I am inclosing a check for $400.00 made out to the order of the "Associated Boards" which will be incorporated with and forwarded with your other monthly drafts to your treasurer in China, who will be instructed to give it to Miss Mary E. Streeter, Dean of Women of West China Union University.

I wish to thank you for your interest and help in getting relief to Miss Streeter, who I understand is in straightened financial circumstances.

Very truly yours,

E G Ackart

EGA S

Inclosure

Check #400.00
Dep. West China
Irving Trust Co.
3/2/44

2822 4425

0011

March 3, 1944

Mr. E. G. Ackart
Nemours Building
Wilmington, Delaware

Dear Mr. Ackart:

I am in receipt of your letter of March 1st enclosing check for $400.00 to be forwarded to China for Miss Mary E. Streeter. This will be forwarded with our next remittance to West China.

We are also sending Miss Streeter the letter which you enclosed, which we believe will get through without any difficulty.

Very sincerely yours,

C. A. EVANS

CAE/B

Mr and Mrs Gordon R. Agnew
1932, 1942-45

R. GORDON AGNEW, B.A., D.D.S., F.I.C.D.
WEST CHINA UNION UNIVERSITY
CHENGTU, SZECHWAN, CHINA

53, Turner Road, Toronto, April 3, '32.

ack. 4/20/32

WEST CHINA TRANSFER

Mr. B.A. Garside,
New York City, U.S.A.

Dear Mr. Garside:

I am enclosing herewith a statement from the Equipment Maunfacturing Company covering an amount of sixty-three Canadian dollars.

You will recall that when you were in Toronto I mentioned this account which has been incurred in connection with the rebuilding of two dental chairs. These chairs were contributed by the Faculty of Dentistry of the University of Toronto, and after necessary repairs etc., they have been put in excellent condition and have been sent to China.

I explained to you that the expenses involved are to be borne by the Faculty of Dentistry in a department other than that with which I am directly connected. Since I am not handling funds for that department, will you kindly forward the amount to the above company and charge against the Faculty of Dentistry.

At the moment, the original invoice is on file in my laboratory, so I presume that this statement will suffice. There will at a later time be probably an additional small amount for a third rebuilt chair which we are hoping to have put in shape to meet the great need at Chengtu.

Thanking you, I am

Very truly yours

R. Gordon Agnew

R. Gordon Agnew.

Paid 4/19/32 $63.00 Canadian
less 9% 5.67
No. #1750 Sold $57.33

See letter to Bursar's Office 4/20/32

R. GORDON AGNEW, B.A., D.D.S., F.I.C.D.
[redacted]
53 Turner Road, Toronto, Ontario.

WEST CHINA

September 30,1932.

Mr.E.A.Garside,
Treas. West China Union University,
New York City.

TRANSFER

Dear Mr.Garside,-

Sometime ago I sent you a bill for repairs and packing of two dental chairs which we were fortunate enough to have given to us for use in the College of Medicine and Dentistry in China. Dr.Lindsay has written me from China to say that these chairs are filling a very great need and are giving excellent satisfaction and also to urge that if possible, I secure a third chair. This I have luckily been able to do and a chair is already prepared for shipment at a cost scarcely above the expense of packing. I am enclosing herewith the statement amounting to ten canadian dollars and fifty cents ($10.50).

Paid 10/5/32
Vo. 1807

Since this equipment as in the former case is not for my own department and does not come within the budget over which I have control, will you kindly settle this account with the equipment manufacturing company?

Thanking you I am,

Very sincerely yours,

R. Gordon Agnew

R.Gordon Agnew.

R.G.A./M.A.
Enclo/

2 8 2

4 4 2 5

0018

WEST CHINA

TRANSFER

November 28, 1932

Dr. R. Gordon Agnew
Board of Foreign Missions
United Church of Canada
299 Queen Street, West
Toronto 2, Canada

My dear Dr. Agnew,

We are getting a great deal of interest aroused here in New York over your luncheon on December 6th. I am hoping that we will have a good attendance, though it is always impossible to get exactly the ones we would like, due to the number of conflicts which inevitably occur.

I have not been able to locate the Professor Wu whom I believe you have suggested as one of those we should invite. Inquiries at the Rockefeller Foundation bring the information that a Professor Hsein Wu has returned to China within the last month. They also have a student from Nanking by the name of Wu Ru-ling who is studying here on a fellowship. Are either of these the one you have in mind?

I tried to get a copy of the article I was telling you about on motion pictures, but found that the supply of "Scouting" for August has been exhausted. I will be glad to send you my copy if you wish, and might mail it to you in advance of your trip to New York if you would have time to glance through it before the luncheon.

Looking forward to having you and Mrs. Agnew here in New York, I am,

Very cordially yours,

B A GARSIDE

BAG:RC

2 8 2

4 4 2 5

0020

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United Church of Canada
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Looking forward to having you and Mrs. Agnew here in New York, I am,

Very cordially yours,

B A GARSIDE

BAG:RC

2 8 2

4 4 2 5

0020

TRANSFER

WEST CHINA

West China

December 1, 1932

My dear Dr. Agnew,

I am attaching a copy of a night letter which I am sending at the request of the publicity group in charge of disseminating information concerning the luncheon next Tuesday. They were somewhat afraid lest there might be a mix-up over these laboratory pictures, which they are anxious to have as promptly as they can be secured. I trust that there will be no inconvenience or difficulty in getting this material for them.

Dr. Tisdall has also asked us to handle the expenses of your journey to New York, and to look to his organization for reimbursement. It seems to me that the simplest way for you to handle this would be for the Board of Missions of the United Church of Canada to advance you whatever funds you need for this trip - at least the trip to New York if not the return to Toronto - and to bill us for the amount, along with the cost of Dr. Endicott's trip. When you arrive in New York we could advance you the cost of your return to Toronto if you had not already received the amount from the U.C.C., and could in fact [redacted] you the entire cost of the journey if you had received nothing from the U.C.C. I suggest this procedure because I have learned of this request so late as to make it difficult for us to get you the funds from here before you leave Toronto.

Looking forward to seeing you next week, I am

Very cordially yours,

BAG/G

B A GARSIDE

2 8 2

4 4 2 5

0021

WEST CHINA

SEATING LIST

FAREWELL LUNCHEON

In Honor Of

Dr. and Mrs. R. GORDON AGNEW

HOTEL ROOSEVELT

December 6th, 1932

Board of Governors

West China Union University

Name	Table	Name	Table
Agnew,Dr.R.Gordon	S	Douglass,Miss Jessie	4
Agnew,Mrs.R.Gordon	S	Dsang,Pres.Lincoln	S
Arnett,Dr.Trevor	4	Dublin,Mr.Louis I.	4
Avallon,Mr.Thomas	2	Endicott,Dr.James	4
Ball,Dr.Louise	3	Flavelle,Sir Joseph	S
Barber,Mr.George G.	2	Franklin,Dr J.H.	5
Barton,Miss Helen	1		
Blakeslee,Mr.HowardW.	2	Galdston,Dr.Iago	6
Bodecker,Dr.Chas.F.	6	Garside,Mr.B.A.	7
Bogert,Dr.L.Jean	5	Gee,Dr.N.Gist	1
Burr,Miss Frances K.	2	Hedrick,Mr.Byron M.	6
Butler,Capt C.S.	3	Hellman,Dr.Milo	1
Cartwright,Mr.F.T.	1	Hirschfeld,Dr.Isador	2
Cattell,Dr.J.McKean	4	Hume,Dr.E.H.	7
Coffin,Dr.Jas.G.	1	Huntington,Dr.G.B.	6
Dean,Dr.H.T.	5	Joy,Dr.James R.	6

Name	Table	Name	Table
Kingsbury,Dr.John A.	3	Stone,Dr.A.Waldron	7
Klein,Dr.Henry	6	Strusser,Dr.Harry	4
		Sydenstricker,Dr.E.C.	1
Laurence,Mr.Wm.A.	8		
Leffingwell,Dr.G.W.	6	Tchou,Col.M.Thomas	8
Leonard,Dr.Harold J.	5	Territerry,Dr.W.S.	5
Luce,Mr.Henry R.	4	Thomas,Mrs.Harrison	7
McBrier,Mr.E.M.	4	Vaughan,Dr.Harold S.	7
McCollum,Prof.E.V.	8	Vaughan,Dr.J.G.	3
Meng,Mr.Chih	1	Vincent,Dr.George E.	6
Messner,Dr.C.T.	2	Walker,Dr.Alfred	3
Owre,Dr.Alfred	4	Warnshuis,Dr.A.L.	5
		Watson,Dr.C.H.	3
Rose,Dr.Mary S.	3	Weiss,Mr.Myron	5
Sakmann,Miss Marianne	7	William,Dr.Maurice	7
Sandberg,Miss Minnie V.	7	Winn,Miss Mary Day	1
Smith,Mr.Barry C.	1	Wynne,Dr.Shirley W.	8

P R O G R A M

Introductory Remarks by Toastmaster

Sir Joseph Flavelle

The Institution which Awaits Dr. and Mrs. Agnew

Pres. Lincoln L. G. Dsang

Brief Resume of Research while on Furlough

Dr. R. Gordon Agnew

Appraisal of Dr. and Mrs. Agnew's Research

Prof. E. V. McCollum

8 copies. Berkshire

Immediate Release

TRANSFER

B.A. Garside
West China Union University
150 Fifth Avenue
New York City

WEST CHINA

NEWS EDITOR:

December 6, 1932

Tooth decay known to medicine as dental caries is primarily due to lack of phosphorus and Vitamin D in the diet it was definitely shown by researches extending over a period of years and recounted today (December 6) by Dr. R. Gordon Agnew of the faculty of West China Union University at a luncheon tendered to him and Mrs. Agnew, a co-worker in the researches, by the Board of Governors of the University at the Hotel Roosevelt here.

Working with hundreds of laboratory animals Dr. Agnew was able to produce tooth decay in practically 100% of the cases by depriving them of these two food elements. The laboratory research has been undergoing a simultaneous check for a period of a year in the diet of 450 children in Toronto institutions, and results so far strongly tend to bear out the laboratory work, Dr. Agnew stated.

"Our extensive experiments on laboratory animals and on humans indicate that phosphorus and Vitamin D are the important nutrient elements in the prevention of dental caries. With the laboratory animal phosphorus assumes the major role, but in the human Vitamin D becomes of great importance," Dr. Agnew stated.

Eating sugar, candy, and other sweets, it was further indicated by these test diets, has no effect in itself in causing tooth decay, except that by satisfying the appetite too quickly it tends to keep down the intake of the foods which contain the elements which do make for sound tooth structure.

Immediate Release

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Professor E.V. McCollum, prominent biochemist of Johns Hopkins University, who was among the distinguished scientists and medical men present, in a formal comment declared the Agnew work was one of the more important chapters in the history of nutritional research and that the findings of Dr. and Mrs. Agnew check completely with the theories recently arrived at at Johns Hopkins after reviewing 20 years of experimental research in this field.

12-6-32

"The inference to be drawn from this research work is that if we get an adequate supply of Vitamin D, drink plenty of milk and eat plenty of vegetables and other foods rich in phosphorus, nearly all of us can avoid dental caries," Dr. McCollum stated. "In that event the attendant diseases largely attributed to dental caries will be materially lessened. How important this is may be judged from the fact that 95% of the school children in America suffer from dental caries."

"Eat what you want after you have eaten what you should," is the advice of Dr. McCollum to the average person. "It so happens that the average American diet is now built around protective foods such as milk, vegetables, eggs and fruit, together with a moderate amount of meat," said Dr. McCollum. "Such a variety of foods is rich in phosphorus and calcium too. In fact, with a little care in our choice of foods, we should easily obtain all of the 37 elements now known to be necessary to our nutritional well-being. One possible exception is Vitamin D. None of the usual foods supply enough of this vitamin, which is found chiefly in fish oils. Its natural source is of course, found in the skin, when activated by the ultra-violet rays of the sun. Unfortunately in this latitude the sun's ultra violet is seldom strong enough to afford an adequate supply of Vitamin D from this natural source, so that it must be supplemented."

Care of the teeth is now a first rule of personal hygiene and good teeth are a paramount requisite to beauty and personal attractiveness, Dr. McCollum pointed out, stressing that the significant fact in Dr. Agnew's findings is that for the first time, consciously and under scientific control, he has succeeded in producing and preventing dental caries practically at will and to a degree approaching 100 per cent.

The research by Dr. and Mrs. Agnew is the

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The research by Dr. and Mrs. Agnew, in the course of which some 3,000 diets were analyzed by Mrs. Agnew, was begun in China in 1922 at the College of Dentistry of West China University, in Chengtu, the only college of dentistry in the Chinese Republic. In 1927 Dr. and Mrs. Agnew left China on a furlough from the university and shortly after arrival in America began their exhaustive studies under the auspices of the Department of Paediatrics and Faculty of Dentistry, University of Toronto.

12-6-32

Sir Joseph Flavelle of Toronto officiated at the luncheon as presiding officer and toast master, and Dr. Lincoln L.G. Dsang, President of West China Union University, delivered a brief speech welcoming Dr. and Mrs. Agnew back to the campus of the University. They are leaving within a few days to resume their work at Chengtu.

West China Union University, which is one of the group of six international Christian Universities in China, is located in the province of Szechwan, and serves one of the most densely populated sections of the Republic including the aboriginal tribal population of the Thibet plains, among whom much of Dr. Agnew's earlier investigations were made.

Summarizing his preliminary studies among the primitive Chinese, Dr. Agnew stated that while "the teeth of some of the tribal people investigated were so heavily coated ... that it was difficult to get at the teeth, yet when uncovered they were found free from dental caries and on the whole were much sounder than the teeth of the average person in this country". Further investigations into the diet of these peoples showed that while there were variations in what the people ate in different parts of the country, estimations indicated adequate phosphorus, and living conditions in China indicated adequate Vitamin D obtained from sunshine except in certain areas. Among the Thibetan tribes in particular, where tooth decay was especially infrequent, while their diet was highly restricted, the eating of whole corn, an important article of their daily food, supplied them with adequate phosphorus while their out of door life in the sunshine assured them of plenty of Vitamin D.

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NEA Service TRANSFER NEW YORK, JANUARY 10, 1933

HOME, CHILDREN, TRAVEL, CAREER---ALL ARE PART OF ONE WOMAN'S BUSY LIFE

* *

Mary Caldwell Agnew Helps Scientist-Husband With Research Work in China

BY JULIA BLANSHARD
NEA Service Writer

NEW YORK, Jan. 00.—In these realistic days, a woman who can find romance, a fascinating career, the lure of foreign lands realized, and make a contribution to science in addition, may well be the envy of her sister-women.

Mary Caldwell Agnew has done just that—all of it!

She has just sailed again, with her scientific-husband, Dr. E. Gordon Agnew, for China, where they will continue research into the causes of tooth decay. Their discovery that lack of phosphorous and Vitamin D is directly responsible for decaying teeth already has been acclaimed as "one of the more important chapters in the history of nutritional research."

As a child in Canada, Mary Caldwell, daughter of a minister, used to dream of some day doing good in the world, perhaps as a missionary in foreign lands. As she grew older, she decided it would be of much more benefit to mankind if she had some trained contribution to make. So she specialized in nutrition and bio-chemistry.

A College Romance

While still in college, she met Dr. Agnew, who then was teaching, and they fell in love. As soon as she graduated, they were married and sailed for China, to build their home in faraway Chengtu, where they both took positions teaching and doing research at the West China Union University. There they worked together, their two children were born, and there they made scientific discoveries that have brought them fame.

"In Chengtu," Mrs. Agnew told me, "we analyzed 3,000 daily diets and found, to our surprise, that on practically the same food generation after generation, the Chinese village folk had sounder teeth than the average American. You see, through the eating of whole corn, they got adequate phosphorous, and through living outdoors practically all the time, they got Vitamin D."

In addition to her fascinating experiments and her teaching, Mrs. Agnew runs their home and cares for their little boy and girl. All her knowledge of housekeeping has been learned in China.

Mary Caldwell Agnew

"We usually have two or three Chinese meals a week but as a rule we have our Chinese cook feed us meals cooked American style. In China there is a lot more to housekeeping than in America. For example, both salt and sugar are bought in chunks and have to be refined in the kitchen. And if you want pork, you know just how fresh it is, because pork is butchered at the university and then cured at home."

Gives Children Freedom

As regards her children, Mrs. Agnew is very modern. She has supervision over them, but leaves them alone to amuse themselves most of the day, until four o'clock when she and the doctor meet them for two hours' mutual enjoyment.

"I think children should be taught to be self-reliant," she said. "The very best way to prepare them for life, it seems to me, is to make them self-reliant from the start, and that applies to their play day. Our children have a grand time and we have found that amusing themselves has developed their imaginaton as well as their self-reliance."

Dr. and Mrs. R. Gordon Agnew

December 6, 19

New York Times
December 7, 1932

24 * * * *

PROVE VITAMIN D HALTS TOOTH DECAY

Dr. and Mrs. Agnew, Honored at Luncheon, Tell of Research With Rats and Children.

PHOSPHOROUS ALSO VITAL

Experiments at Toronto Indicate Sweets Affect Teeth Only by Restricting Normal Diet.

Tooth decay, the common malady of civilized man, is primarily due to a lack of phosphorus in the diet and a lack of vitamin D, obtained when the skin is exposed to sunshine or by the consumption of fish oils, it was shown definitely through researches carried on by Dr. R. Gordon Agnew of the faculty of West China Union University and revealed by him yesterday at a luncheon in his honor at the Hotel Roosevelt.

Dr. Agnew and his wife, who is his co-worker, began their work in Szechwan, the province where the university is situated, and continued it while on furlough at the University of Toronto. They have been able for the first time to produce and prevent tooth decay in rats, to a degree approaching 100 per cent, by including and omitting these elements. Simultaneously they have checked the laboratory research by means of an experimental control of the diet of 350 children in Toronto institutions, revealing that with the rat phosphorus is most important in producing immunity to decay, while in humans vitamin D becomes of great importance.

The study of the children is still going on and final results have not been announced, but an interim examination of a representative group of them indicates that in those who have received additional vitamin D, there is a definite trend toward lessened incidence of tooth decay as compared with those on the usual normal diet, containing normal phosphorus and calcium rations.

"Moreover," Dr. Agnew added, "the tendency in the children with more vitamin D is toward an arrest of decay in previously existing cavities. The general tone of the gums and of the mucous membrane of the mouth of these children showed an improvement as contrasted with the gum and mouth condition of those who had not been given the extra supply of vitamin D."

The research and findings of Dr. and Mrs. Agnews, conducted under the auspices of the department of pedatrics and the faculty of dentistry of the University of Toronto, received the endorsement and prase of Dr. E. V. McCullom, Professor of Biochemistry at Johns Hopkins University and an authority on nutrition, who was another speaker. Dr. McCullom is in New York attending the Greater New York December meeting for better dentistry in session at the Hotel Pennsylvania.

Dr. McCullom pointed out that he and his associates and other research workers had held the theory that deficiency of phosphates and of vitamin D, which is the active agent vital to increase its utilization, were the primary causes of tooth decay, and had made experiments tending to show this. But Dr. Agnew's experiments, he said, were the most satisfactory experimental studies yet made proving that under conditions of Western civilization these deficiencies are chiefly responsible.

Dr. Agnew said the diet tests had indicated further that eating sugar, candy and other sweets had no effect in itself in causing tooth decay, except that by satisfying the appetite too quickly it tended to keep down the intake of the foods containing the elements which make for sound tooth structure.

FINDS TOOTH DECAY A PUZZLE.

Dr. Kugelmass Tells Dental Session It Affects All Classes.

The seeming anomalies in tooth decay, which "is not arrested by any of the current methods, dental or medical," were discussed at yesterday's sessions of the Greater New York December meeting for better dentistry at the Hotel Pennsylvania by Dr. Newton Kugelmass of this city.

Dr. Kugelmass, who emphasized the importance of dietary factors, pointed out that tooth decay is rare among primitive peoples and becomes rampant in civilization, and that it is widespread among rich and poor, urban and rural, among those in good general health as well as those with systemic diseases.

Dr. Alfred Walker declared that "dead tooth as applied to pulpless teeth is a misnomer and the term has been employed far too often for the purpose of frightening the patient." "Countless hundreds of thousands of teeth have been needlessly sacrificed because of the fear thus created and millions of dollars have been expended in replacing the teeth thus lost," he added.

Dr. Walter E. Briggs of Attleboro, Mass., said the object of preventive dentistry was the stamping out of dental disease in its incipient stages by the eradication of pits and fissures. Fully 90 per cent of oral disease and the train of systemic infections that follow, he said, could be prevented if the proper care were given to these initial defects.

Dr. and Mrs. R. Gordon Agnew

WEST CHINA

December 6, 1932

NEW YORK HERALD TRIBUNE, WEDNESDAY, DECEMBER 7, 1932

Scientists Find Diet Can Halt Decay of Teeth

Dr. R. G. Agnew Announces Discovery Here After 9-Year Research in China

Wife Aided Experiments

Phosphorus and Vitamin Called Control Agents

Dr. R. Gordon Agnew, member of the faculty of West China Union University, of Chengtu, in Szechwan Province, China, a thousand miles from the coast, announced yesterday before a gathering of scientists at the Roosevelt that he and his wife, after working for nine years, had found that decay in human teeth results from an insufficiency of phosphorous and vitamin D in diet.

Dr. Agnew, a young Canadian, said that he and Mrs. Agnew, who also was present at the meeting, had been able, both in Peiping and in Torinto, in experiments performed on thousands of rats, to produce and to prevent tooth decay in almost 100 per cent of the cases by the addition or by the subtraction of this one element and this one vitamin.

As soon as Dr. Agnew finished his report, Dr. E. V. McCollum, professor of bio-chemistry at Johns Hopkins University, in Baltimore, and discoverer of vitamin D, rose and announced that "what we have just heard constitutes an extract from one of the most important chapters in the history of nutritional research. It marks another milestone in scientific progress toward bettered human health and wellbeing through knowledge of the biological effects upon us of the food we eat."

Foresees Prevention of Decay

Dr. McCollum also said "The significant, vital fact is that the Agnews for the first time, consciously and under scientific control, have succeeded in producing and preventing dental decay, practically at will and to a degree approaching 100 per cent. The Agnew work gives further strength to the conclusion that dental decay can be largely, perhaps wholly, prevented by correct eating. In the light of this it is likely that tooth decay, the suffering incident to it and the many diseases which are directly or indirectly due to decayed teeth will be minimized."

Dr. Agnew made his report to about a hundred leading scientists of the country, all of whom had been invited to the meeting by the board of governors of the West China Union University, which is a Protestant institution supported by American, Canadian and British churches. Sir Joseph Flavelle, Canadian banker and philanthropist and honorary chairman of the board of governors of the university, came to New York from Toronto to preside at the luncheon.

Sir Joseph said research in dentistry was begun at West China Union about ten years ago after a member of the faculty was obliged to take four months off to make a trip to Shanghai and return, because of trouble with his

"Dr. and Mrs. Agnew," he said, "went to join the medical faculty of the school for three reasons—religious, educational and medical. This western part of China is one of the few remaining parts of the earth where life is lived and nourished in practically the same way as it was 4,000 years ago. The Agnews soon found that few of the Chinese in that section had decayed teeth and they at once began to study what they ate."

Found Natives' Teeth Sound

Dr. Agnew said that "while the teeth of some of the tribal people investigated were so heavily coated that it was difficult to get at the teeth, yet when uncovered they were found free from dental caries and on the whole were much sounder than the teeth of the average person in this country. Further investigation into the diet of these people showed that while there were variations in what the people ate in different parts of the country, estimations indicated, even in their restricted fare, adequate prosphorus and living conditions in China indicated adequate vitamin D obtained from sunshine, except in certain areas.

"We found among the Tibetan people in particular, where tooth decay was especially infrequent, that while their diet was highly restricted, the eating of whole corn, an important article of their daily food, supplied them with sufficient phosphorus while thier outdoor life in sunshine assured them of plenty of vitamin D."

Dr. Agnew also reported that he and Mrs. Agnew, during their work under the auspices of the department of pediatrics and the department of dentistry at Toronto University, had found that the eating of sugar, candy, and other sweets had no effect in itself in causing tooth decay except that by satisfying the appetite too quickly it tended to keep down the intake of foods which contain the elements which do make for sound tooth structure.

Need More Vitamin D

"It so happens that the average American diet is now built around protective foods such as milk, vegetables, eggs and fruit, together with a moderate amount of meat," Dr. McCollum said. "Such a variety of foods is rich in phosphorus and calcium, too. In fact, with a little care in our choices of foods, we should easily obtain all of the thirty-seven elements now known to be necessary for our nutritional well-being. One possible exception is vitamin D. None of the usual foods supply enough of this vitamin, which is found chiefly in fish oils, when activated by the ultra-violet rays of the sun. Unfortunately in this latitude, the sun's ultra-violet rays are seldom strong enough to afford an adequate supply of vitamin D from this natural source so that it must be supplemented."

One of the leading New York dietitians said yesterday that phosphorus is contained in cheese, egg yolk, dried beans, whole wheat, nuts, prunes, lean beef and in oatmeal. She said the only foods vitamin D was contained in were egg yolk, to a slight degree, and in certain fish after they had been irradiated.

Dr. Lincoln L. G. Dsang, president of West China Union University, who is in America on a visit, attended the luncheon. Also at the speaker's table was Colonel Thomas Tchou, a member of the Chinese Industrial Commission now in the United States. Dr. and Mrs. Agnew will leave within a few days to resume their work in Chengtu.

WEST CHINA

West China Union University

December 8, 1932

Dr. R. Gordon Agnew
53 Turner Road
Toronto, Canada

My dear Doctor Agnew:

I am enclosing herewith a rough draft which Miss Sahmann has prepared of your address at the luncheon this week. Will it be possible for you to find time to go through and correct this draft and hand it back to us before you leave Toronto? Sorry to add another item to the pressure of last minute things which must be attended to.

You will note that this is not at every point a verbatim transcript of what you said, but at some places is more of a summary. Please feel free to elaborate as well as to correct.

With all good wishes for a pleasant journey and a happy period of service in West China, I am,

Very cordially yours,

B A GARSIDE

BAG:RC
Enc.

Farewell Luncheon in Honor of Dr. and Mrs. R. Gordon Agnew

December 6, 1932

Sir Joseph. Because some of our friends have to get away in fair time, it is desirable that we should proceed with the exercises that follow the luncheon.

The Society of Friends of Great Britain, the Methodist Episcopal Church of the United States, the Baptist Church, North, of the U. S., and the Methodist Church of Canada, all shared in missionary enterprise in West China. Their field was the great problems of Szechwan alleged to be the most prosperous province in China containing 60 million people, with Chengtu as capital. As time went on the necessity for a training school, a school for advanced teaching, and for development of leadership for the work which had to be carried on in China led to a recommendation from the field and following it a conference in the respective foreign Mission Boards of the churches in question including the Quaker friends from Great Britain to see what could be done whereby general, middle school, and university work should all be undertaken on behalf of these bodies. Wisely they decided that if possible they should have a united effort in the university work. The agreement which was reached was loose in character, the agreement of Christian bodies to work together and to share together. This was the beginning of what has now turned out to be West China Union University. The teaching body from the first was drawn from the missionaries on the field for these respective home churches. Pressure for new teachers came from the field where need was understood. Gradually forces were augmented. Salaries for the teachers thus employed were paid by the respective missions. The Board which administered the University had no responsibility on that side until work grew to such proportions that sometimes it was necessary to engage teachers other than were supplied by the missions, chiefly, in fact

exclusively, chosen from Chinese graduates or Chinese scholars.

In due course our friends of the Church Missionary Society, who also had work in Szechwan, asked to join forces; so did the Woman's Missionary Society of the United Church of Canada and the woman's societies of the Baptist and Methodist bodies, thus adding to the original number of 3 or 4 Boards a further body of 4 supporters. Work is carried on and has been carried under guidance and instructions and help and counsel of these bodies.

During the processes of the early mission days - and this is one of the reasons why we meet here today - one of the missionaries of the Methodist Church of Canada had a very sore tooth. For the purpose of having it attended to he had to go to Shanghai. It took four months to go to Shanghai and come back, 1600 miles up the river and 300 miles across the country. Because this good brother had to be sent down to Shanghai, his fellows in the field wrote home to the home board and said: Send us out a dental missionary. So it has fallen to the honor of this singularly isolated university to have grown into the only university in the whole of China giving a full dental course. And out of it, out of that service, out of that work there are at the present time on the staff of the United Church of Canada six dental missionaries on the field, five of whom are members of the University staff.

I will content myself with those few comments at the moment. I wanted to leave with you a brief sketch of the manner in which West China Union University commenced. I don't know whether we have present with us some of the foundations which are established so generously and liberally in your great community. There will not be time for Dr. Agnew to speak of the need. The need is for more staff. The pity of it is that men and women are available at home ready to go. And the need yonder is the need of 60 million people. And it is not possible to supply the need at the moment because the respective missions are without sufficient funds. Need

for equipment and supplies. I was reminded of this yesterday as I left Toronto when I saw a letter from a member of the staff of West China Union University to an old teacher of his. Is it possible for you, he asked, to get me $500 worth of equipment for the work that we want to do in biochemistry. He could do with three times that, but in his modesty he would not ask for more.

Just one more word. I am told that 450 years before Christ the philosopher Moti in times of trouble, disorder, conflict promulgated the idea that what was lacking in men was mutual love. When Jesus was asked: Master, which is the greatest commandment, He replied: Thou shalt love the Lord Thy God with all thy heart and with all thy soul ..... and the second is like unto it; thou shalt love thy neighbor as thyself. upon these two..... We made a try of loving money, of loving power, carrying selfishness in our hearts, every man for himself. We have tried it in international affairs, and we made a poor job of it. Men say that these high idealisms of Jesus are for women and children, but I wonder if there is anything in the field of human endeavor, anything that takes more red blood. If there is anything that this poor old and distressed world needs, it is international goodwill that we may have constructive and helpful interchanges and in our national life that each man think of the other rather than himself.

My duty directs me to introduce to you the President of the University, who is to speak upon the institution at which Dr. and Mrs. Agnew have done a great deal of their work. The President of the University is a graduate of the University. After graduation he crossed to this side and took a postgraduate course on this side; then he returned to the duties on the field. He was elected as Vice-President where he has done careful and consistent service. And when in the judgment of our Chinese friends it was necessary that we should have a Chinese President and that we should have

a Board of Directors the majority of whom were Chinese, the unanimous choice fell upon our friend President Dsang.

President Dsang. Mr. Chairman, Dr. and Mrs. Agnew, ladies and gentlemen. I deem it a high honor to be here today to meet so many distinguished friends and guests at such a farewell gathering for my personal friends.

However, my position today makes it a little bit embarrassing to speak any word. Just like man who was invited to dinner which his own cook had prepared.

One word to represent my University, my own Alma Mater, a word of welcome to Dr. and Mrs. Agnew. My dear friend, you certainly chose very wise place to serve. I will tell you reasons. I know from five years study and five years service how important that institution is. Geographically that institution not only means whole province bigger than Japan, over 70 million people. Our University not only serves them directly so far as higher education, and especially dental and medical work is concerned, our service also reaches at least nine other provinces which are bigger than one half of the whole United States. There are no schools of higher education, in medicine, and dentistry, and our graduates from medical and dental school serve such a tremendous territory there. That is the kind of institution that is waiting and which you are going to serve.

Not only 150 million people. They need not only medicine and dentistry. Due to years of disturbance they are busily engaged in all sorts of trouble, inside and outside. People are left there neglected. Government cannot help them. There are no well-equipped government hospitals for the poor people. It is the poor people that we need to help. We cannot say China has no medicine and dentistry. Certainly in China doctors and dentists know how to charge. Medical service is not shared by the poor people. They cannot get it. My operation cost me $5 in a mission hospital. In Shanghai

one of my friends had to pay $300.

Christian love, sacrificial spirit. Example of the good people. When they go out they have different attitude. Partly of course they have to make money for themselves, but they also want to serve the poor people. Christian love we need in China. You are very wise to choose that particular field and that particular institution.

Within the last few days I received a letter from China saying that students had increased one half over last year. This is mostly because dental and medical college is so attractive. It means pioneer service. Training Chinese leaders. May God bless you. When I return to West China next summer, I want to see you just as happy as you are today.

Sir Joseph Flavelle. Dr. and Mrs. Agnew are both graduates of the University of Toronto. Dr. Agnew after completing his work was offered a two year fellowship. At the end of this time he and his good wife offered themselves for service in the missionary field. Since 1923 they were carrying on their work in China and returned here for a year's furlough and have spent nearly the whole of the year in extensive research work with feverish attention commanding the admiration and support of the men associated with the University of Toronto and of the men associated with the hospitals.

It is really our privilege and our honor to have these two people, Christian people, leaders of the work of the Lord Christ, turning down offer after offer with emoluments of first grade character, returning to their work as soon as they finish up the records.

I have the great pleasure in introducing to you Madame. Studied nutrition, taught it in China, carried on the records for her husband. It has come to be "the Agnews." - I have the pleasure in introducing Dr. Agnew.

Professor E. V. McCollum

Mr. Chairman, Ladies and Gentlemen, I enjoyed very much the privilege of being here today, the privilege to meet Dr. and Mrs. Agnew, and to see again, because I have already seen, the illustrations of specimens which they have prepared showing the results of their study on the effects of various kinds of faulty diets on the preservation of the health of the teeth.

What the nutrition investigators have been attempting to do over a period of something like 30 years is to learn all that we can learn about the chemical composition of the simplest adequate diet. We wish to learn to visualize the simplest diet in terms of the simplest chemical substances which constitute a complete list of those building stones with which the body must be provided in order that growth may be normal or that progress may work smoothly. We must eventually know in terms of very simple chemical things just what constitutes an adequate diet. There are still gaps in our knowledge at the present time.

With an assurance beforehand that what I tell you is not sufficiently complete, I wiil list the substances which have been recognized as necessary in the nutrional investigating field. There are first of all approximately 18 digestion products of protein. Then we must have a source of energy in form of glucose; sugar in the blood. This makes 19 things. There must be eleven inorganic elements: Sodium, calcium, phospherus, iron, magnesium,

There are little things that the diet must contain. There are at least six substances which are indispensable, called Vitamins. Some more may evemutally come to light. 36 little things which the diet must provide. A 37th substance, acid, was demonstrated to be necessary. Insofar as re-

search has progressed we have found that when diet is satisfactory in respect to 36 substances the functions of the body work smoothly. Lack in one, no matter which, may lead to physiological failure. We have seen perhaps ten of them uncomplicated in the laboratory. You can appreciate the importance ~~of this~~ from the standpoint of the physiologists or the medical or dental student of a knowledge of physiological processes of the body. On the other hand knowledge must be as complete as we can make it of the material with which nutrition begins, the things which we must provide in the diet. One of the fields of study therefore is that of observing a specific type of pathology which results from a specific deficiency.

Naturally because of the tremendous importance from the standpoint of medicine and preventive medicine of the health of the teeth, numerous investigators have for years been interested in the problem of the development of the teeth, i.e., the conditions of nutrition under which enamel and dentine are perfectly formed, interested in the discovery of those specific types of malnutrition which undermine the structure of the teeth during the developmental period. I have myself been occupied for years with this question. More recently Dr. Klein and I have pursued this kind of work. Mrs. in England. Dr. Bodecker, Dr. and Dr. have contributed to the growth of our knowledge in this field. Dr. Klein and I have come to the conclusion some time ago that the element of primary importance in the preservation of the teeth under our system of nutrition was probably the element of phosphorus. We are getting too little of it. The particular Vitamin which is concerned with the regulation of phospheras and calcium metabolism is Vitamin D.

It was very gratifying to me to learn from Dr. Tisdall during the last year of the extraordinary research which Dr. and Mrs. Agnew had been conducting in Toronto. The plan was a magnificent one. Demonstration of principles through animal experiments. Study on institutional children

of soundness of conclusions drawn from animal studies. Technique admirable. Loyalty is also admirable in the highest degree. The scientific attitude, open-mindedness and the critical outlook which they have maintained all through this work I cannot praise too highly. Their results from the standpoint of illustrated specimens such as you have had the privilege of seeing on the screen are very excellent and very convincing. I want therefore to congratulate you on the admirable piece of work which you have had the good fortune of carrying out.

Luncheon closed by Sir Joseph Flavelle.

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THE PRODUCTION AND PREVENTION OF DENTAL CARIES*

By MARY CALDWELL AGNEW, M.A., R. GORDON AGNEW, B.A., D.D.S., and FREDERICK F. TISDALL, M.D., F.R.C.P.(c)

PROBABLY the earliest record of the occurrence of dental caries is found in the writings of the Chinese Emperor Huang Ti,[1] about 2570 B.C. Dental disease is divided by this writer into three types: *fong ya,* or inflammatory conditions; *chong ya,* or caries, and *ya kan,* or diseases of the soft investing tissues.

Dental disorders were not limited to the ancient Chinese, the early Egyptians being similarly afflicted. Evidence of this has been obtained both from a study of their ancient inscriptions and from examination of their skulls. Using the latter method, Elliott Smith[2] found that the well-to-do classes that lived on luxurious diets showed dental caries and alveolar abscesses as commonly as do Europeans today. The poorer classes that lived on coarse uncooked diets were relatively immune to these diseases.

The examination of 364 skulls dating from the Stone Age,[3] which were found in England, reveals the presence of caries in only sixty-four instances; which would indicate that it was much less common in those far-off times than it is at present.

Evidence that dental disease occurred among the Greeks is shown by the writings of Hippocrates (400 B.C.),[4] who supported the idea that toothache was caused by stagnation of depraved juices in the tooth, and, later, by Aristotle (384-322 B.C.),[5] who suggested, with

*From the Department of Paediatrics, University of Toronto; under the direction of Alan Brown, M.D., and the Faculty of Dentistry, West China Union University.

1. Agnew, R. G.: J. West China Border Res. Soc., 3:61, 1926-1929.
2. Smith, E., quoted by Ruffer, M. A.: Studies in Paleopathology of Egypt, University of Chicago Press, 1921, p. 293.
3. Mummery, J. R.: Tr. Odont. Soc. Great Britain, 2, 1870.
4. Guerini, Vincenzo: History of Dentistry. Philadelphia: Lea & Febiger, 1909, p. 47.
5. Footnote 4, p. 61.

Reprinted from The Journal of the American Dental Association, Vol. XX, Pages 193-212, Feb. 1933.

his remarkable acuity, that the viscous softness of the fig caused small particles to adhere to the gums and insinuate themselves into the dental interstices where they very readily became the cause of putrefactive processes, with resultant damage to the teeth. Unfortunately, there is no statement in the work of these Greek authors on the relative prevalence of the disease. The first suggestion that caries is associated with defective nutrition comes from Galen (second century A.D.),[6] who stated that a deficiency of nourishment not only caused the teeth to die away but also enlarged the cavities.

Fig. 1.—Normal jaw of rat showing six lower molar teeth (dried). The shadows in the sulci do not indicate pathologic change but are due to the narrow deep grooves characteristic of the rat molar. Absence of disease was confirmed by subsequent microscopic examination.

In more recent times, the writings of Krauterman (1732),[7] Bourdet (1757),[8] Bucking (1782),[9] and Tomes (1873),[10] give evidence of the prevalence of caries. During the past twenty years, numerous surveys[11] have indicated that approximately 95 per cent of children suffer from this disease. At the present time, there is probably no other disease to which the human body is heir that is so widespread or so fraught with potential danger to the health of the individual.

As one would expect, a tremendous amount of work has been done in an attempt to discover the various factors in the development of this common disease. In this paper, no attempt will be made

Fig. 2.—Carious molar teeth in rat (dried lower jaw). The microscopic similarity to human occlusal caries as to areas involved and contours of cavities is evident. There is an absence of cusp fracture or other artefact.

6. Footnote 4, p. 108.

7. Krauterman: Sicherer Augen-und Kahnarzt, 1732.

8. Bourdet: Retherches et observations sur toutes les parties de l'art du dentiste, 1757.

9. Footnote 4, p. 321.

10. Tomes, C. S.: Manual of Dental Anatomy, Philadelphia: P. Blackiston's Son & Co., 1914.

11. Milberry, G. S.: Mouth Health Quarterly, 1, No. 1 (Oct.) 1931. Howe, P. R., Mouth Health Quarterly, 1, No. 1 (Oct.) 1931. Brekhus, P. J.: Report on Dental Caries in 10,445 University Students, J. A. D. A., 18: 1350 (July) 1931. Van Ingen, P.: White House Conference on Child Health and Protection, New York: Century Company, 1932, p. 96.

to discuss this work in detail, as this has been done adequately by Mellanby,[12] Bunting,[13] Kesel,[14] Hatton,[15] Bing[16] and others; but a brief review of some of the recent work will perhaps not be out of place.

One of the earliest experimental studies on the relation of diet to dental caries was started by May Mellanby[17] in 1917 and is still being carried on. Her results up-to-date have led her to conclude that "the problem of dental caries and periodontal disease is fundamentally a problem of nutrition" and that a lack of vitamin D is an important etiologic factor. Howe[18] reported that by feeding guinea-pigs diets deficient in the fat soluble vitamin (since known to consist of both vitamin A and vitamin D) and the antiscorbutic vitamin, definite lesions in the teeth quite similar to dental caries were produced.

Experimental production of carious lesions in the rat analogous to those found in man was accomplished by McCollum and Grieves[19] in 1922 by disturbing the calcium and phosphorus balance in the diet and by giving an insufficient amount of the fat soluble vitamin (vitamins A and D). Toverud[20] was able to cause caries-like lesions in rats by feeding diets low in calcium and fat soluble vitamins.

In 1925, Bunting[21] reported that when he reduced the calcium and butterfat in McCollum's stock diet to below that required by the animal, caries-like defects resulted. Marshall[22] reported that similar lesions developed in older rats that were fed diets deficient

TABLE 1.—ABSENCE OF CARIES IN ANIMALS FED NORMAL DIETS*

Diet	Age of Rats Months	No. of Rats	Macroscopic Caries	Microscopic Caries
Diet 1....	2 to 5	21	o	—
Diet 1....	6 to 12	138	o	24 examined, no caries found
Diet 1....	12 to 18	30	o	—
Diet 11-A	2 to 5	73	o	23 examined, no caries found
Diet 11-A	6 to 13	103	o	24 examined, no caries found
Total		365	o	71 examined, no caries found

* In this and the following tables +, denotes presence of caries; o, absence of caries; —, not examined microscopically.

12. Mellanby, May: Experiments on Dogs, Rabbits and Rats, and Investigations on Man, Which Indicate Power of Certain Food Factors to Prevent and Control Dental Diseases, J. A. D. A., 17:1456 (Aug.) 1930.

13. Bunting, R. W.: Review of Recent Researches on Dental Caries, J. A. D. A., 18: 785 (May) 1931.

14. Kesel, R. G.: What Do We Know About Dental Caries? (A Critical Review of Recent Investigations), J. A. D. A., 19:903 (June) 1932.

15. Hatton, E. H.: J. A. D. A., Caries: Résumé of Knowledge of Its Action, Together with Some of the More Recent Research Work, 19:1398 (Aug.) 1932.

16. Bing, F. C.: Diet and Teeth, J. A. D. A., 19:1843 (Oct.) 1932.

17. Mellanby, May: Lancet, 2:767 (Dec. 7) 1918.

18. Howe, P. R.: D. Cosmos, 62:921 (Aug.) 1920; J. A. M. A., 79:1565 (Nov. 4) 1922.

19. McCollum, E. V.; Simmonds, Nina; Kinney, E. M., and Grieves, C. J.: Johns Hopkins Hosp. Bull., 33:202 (June) 1922. Grieves, C. J.: J. A. M. A., 79:1567 (Nov. 4) 1922.

20. Toverud, G.: J. Biol. Chem., 58:583 (Dec.) 1923; Experimental Studies on Physiological and Pathological Chemistry of Teeth, Oslo: Fabritius and Sonners, 1926.

21. Bunting, R. W.: D. Cosmos, 67:771 (Aug.) 1925.

22. Marshall, J. A.: Dental Caries and Pulp Sequelae from Experimental Diets, J. A. D. A., 19:3 (Jan.) 1927.

TABLE 2.—EFFECT OF FEEDING DIETS NORMAL IN CALCIUM AND LOW IN PHOSPHORUS AND VITAMIN D ON THE PRODUCTION OF CARIES*

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	4.00	—	28.5	+	+
2	4.00	—	—	o	+
3	4.50	—	30.1	+	+
4	6.00	3.7	38.5	+	+
5	4.00	—	24.3	+	+
6	4.00	—	26.3	+	+
7	4.00	—	29.3	+	+
8	4.25	—	43.7	+	+
9	4.5	—	27.2	+	+
10	4.75	1.8	34.0	+	+
11	4.75	2.6	47.3	+	+
12	4.75	—	29.5	+	+
13	4.75	1.5	42.0	+	+
14	3.00	—	22.3	+	+
15	4.25	—	27.1	?	+
16	4.00	—	36.0	+	+
17	4.75	—	32.4	+	+
18	5.00	—	29.4	+	+
19	5.00	—	28.0	+	+
20	6.00	—	29.9	+	?
21	5.75	—	26.1	+	+
22	6.00	—	29.4	+	+
23	2.75	—	—	?	+
24	4.25	—	—	+	+
25	4.25	—	24.1	+	+
26	4.25	—	29.7	+	+
27	4.25	—	35.7	+	+
28	7.50	3.2	40.0	+	+
29	4.25	—	30.3	+	+
30	2.00	—	37.2	+	+
31	2.75	—	37.8	+	+
32	2.75	—	41.8	+	+
33	4.50	—	42.0	+	+
34	4.75	5.6	32.5	+	+
35	4.75	3.5	36.6	+	+
36	6.00	2.4	50.9	+	+

*Rats 1 to 29 were fed on diet 44 (calcium 0.825 per cent and phosphorus 0.260 per cent), and rats 30 to 36, on diet 43 (calcium 0.625 per cent and phosphorus 0.260 per cent).

in fat soluble vitamins. Shibata, in 1929,[23] found that dental caries appeared in rats given a diet of rice and greens with 5 to 10 per cent of various sugars, and this was confirmed by Rosebury[24] in 1932. Hoppert, Webber and Canniff[25] state that caries appeared in adequately fed rats when the diet was coarsely ground. Klein and McCollum[26] found that a low phosphorus intake increased susceptibility to caries.

Results contrary to those already reviewed were reported by Blackberg and Berke[27] in 1932. They state that when they added extremely large amounts of viosterol to Steenbock's rachitogenic diet (which has a very low phosphorus content), carious lesions developed in young rats after a period of about five months. The amount of viosterol was gradually increased until an amount equivalent to about 60 drams of cod liver oil was fed daily. When a diet high in phosphorus was fed, Klein and Shelling[28] found that excessive doses of vitamin D did not cause caries and therefore concluded that ingestion of an excessive amount of this vitamin is not a direct cause of the disease.

It is evident that there is marked diversity of opinion as to what is the cause of experimental caries, as a lack of various vitamins, an excess of vitamin D, a deficient supply of the minerals calcium and phosphorus and the consistency of the food have all been considered etiologic factors in the development of this disease.

Studies on the etiology of human caries have been made by Mellanby,[12] Bunting,[13] Jones,[29] Boyd and Drain,[30]

Fig. 3.—Carious molar in upper jaw of rat. There is extensive loss of the occlusal portion of the crown uncomplicated by fracture.

Fig. 4.—Molar teeth of rat (dried lower jaw) free of carious lesions. This rat was fed diet 46, which is normal in calcium and phosphorus but low in vitamin D. The diet of this rat was identical with that used in the case illustrated in Figure 2, with the exception that phosphorus was added. A similar normal appearance was found in those rats in which no evidence of caries was seen when vitamin D was added but the phosphorus kept at the original low level (diet 43-A) (Table 6).

23. Shibata, M.: Jap. J. Exper. Med., 7:247 (April 10) 1929.

24. Rosebury, T.; Karshan, M., and Foley, G.: J. D. Res., 12:464 (June) 1932.

25. Hoppert, C. A.; Webber, P. A., and Canniff, T. L.: Science, 74:77 (July 17) 1931; J. D. Res., 12:161 (Feb.) 1932.

26. Klein, Henry, and McCollum, E. V.: Science, 14:662 (Dec. 25) 1931.

27. Blackberg, S. N., and Berke, J. D.: J. D. Res., 12:609 (Aug.) 1932.

28. Klein, Henry, and Shelling, D. H.: J. D. Res., 11:458, 1931.

29. Jones, Martha R.; Larson, N. P., and Pritchard, G. P.: D. Cosmos, 72:439 (May), 574 (June), 685 (July) and 797 (Aug.) 1930.

30. Boyd, J. D., and Drain, C. L.: J. A. M. A., 90:1867 (June 9) 1928. Boyd, J. D.; Drain, C. L., and Nelson, M.: Am. J. Dis. Child., 38:721 (Oct.) 1929.

Hanke,[31] Hawkins,[32] Price,[33] McBeath[34] and others. Mellanby is of the opinion that vitamin D either in the form of cod liver oil or viosterol will prevent caries. Bunting emphasizes the importance of *Bacillus acidophilus* in the mouth for the production of caries, but believes that "the diet may affect the hygiene of the mouth and the activity of the aciduric bacteria directly through the character of the retained food materials or indirectly through metabolism and alterations in the salivary secretions." He does not consider that any one factor in the diet is responsible for this action.

Jones found that in children 3 years of age or older, diets containing fruits and vegetables in amounts sufficient to produce an alkaline ash were invariably associated with sound enamel or arrested decay regardless of how the diet was otherwise constituted. Boyd and Drain believe that the tooth integrity may depend on the adequacy of the diet in *all* essential factors. Hanke states that inflammation of the gums and dental caries either disappear or are greatly alleviated when a pint of orange juice and the juice of one lemon are added to the daily diet. Hawkins found that individuals that were immune to dental caries consumed liberal amounts of foods which are high in alkaline ash, in calcium and in vitamin D, and low in cereal products. Price believes that dental caries can be largely prevented or controlled by feeding foods sufficiently high in minerals and activators (vitamins). McBeath obtained increased resistance to dental caries by dietary means, but states that "thus far the super importance of any one dietary factor has not been demonstrated."

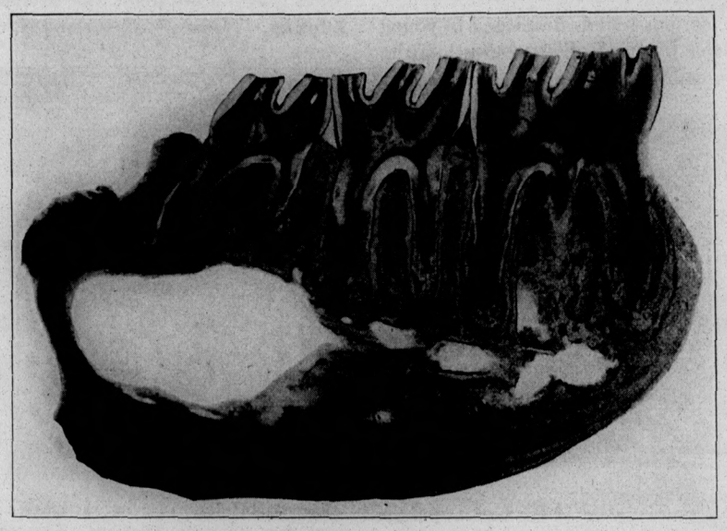

Fig. 5.—Jaw of rat ground mesiodistally showing three molar teeth of one side free of carious defects. There are deep narrow sulci between the cusps and the intact enamel.

31. Hanke, M. T.: Relation of Diet to General Health and Particularly to Inflammation of Oral Tissues and Dental Caries, J. A. D. A., 17:957 (June) 1930; J. Nutrition, 3:433 (Jan.) 1931.

32. Hawkins, H. F.: J. D. Res., 11:201 (April) 1931; What Is Cause of Caries and Systemic Pyorrhea? J.A.D.A., 18:943 (May) 1931.

33. Price, W. A.: Control of Dental Caries and Some Associated Degenerative Processes Through Reinforcement of Diet With Special Activators, J. A. D. A., 19:1339 (Aug.) 1932.

34. McBeth, E. C.: J. D. Res., 12:538 (June) 1932.

As with the experimental production of caries in animals, human studies also reveal no unanimity of opinion as to the exact cause of this disease. The majority of investigators believe that diet is of great importance in the prevention of caries.

Two of us (R. G. A. and M. C. A.) attempted the experimental production of caries in rats in China in 1927 under the Rockefeller Foundation by feeding a diet low in vitamin D. In 1930, in the University of Toronto, an extensive program was instituted through a joint effort made by the Department of Paediatrics and one of us (R. G. A.). In approaching the problem of producing dental caries in animals by nutritional means, it was felt advisable to make as few variations in the diet as possible. It is now recognized that there are at least thirty-seven elements necessary for normal nutrition,[35] namely eighteen amino-acids, one fatty acid (linolenic acid), glucose, eleven minerals and six vitamins. While a lack of any of these substances will interfere with the health of the animal as a whole, the close relationship between certain of these elements and definite pathologic conditions is well recognized. For instance, the relation of iodin to the production of goiter, of vitamin C to scurvy, of vitamin D to rickets, and of iron and copper to anemia. It is not unreasonable, therefore, to consider that a limited number of these elements may be intimately connected with the normal nutrition of the tooth, and, conversely, that a lack of these elements may result in the development of certain disease conditions, including caries.

As the tooth is composed to a large extent of calcium and phosphorus, and as it has been established that vitamin D is essential for the optimal utilization of these elements by the body, our attention

Table 3.—Lack of Preventive Effect on Production of Caries of Addition of Vitamins A, B_1, B_2, C and E to Diet 43. (Diet 45 [Calcium 0.630 Per Cent and Phosphorus 0.284 Per Cent].)

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	2.50	—	38.8	?	+
2	2.50	—	—	+	+
3	7.00	2.2	49.5	+	+
4	2.00	—	48.0	+	+
5	2.00	—	50.3	+	+
6	2.00	—	42.7	+	+
7	2.25	—	—	+	+
8	4.00	—	47.7	+	+

Two of us (R. G. A. and M. C. A.) attempted the experimental production of caries in rats in China in 1927 under the Rockefeller Foundation by feeding a diet low in vitamin D. In 1930, in the University of Toronto, an extensive program was instituted through a joint effort made by the Department of Paediatrics and one of us (R. G. A.). In approaching the problem of producing dental caries in animals by nutritional means, it was felt advisable to make as few variations in the diet as possible. It

35. McCollum, E. V.: Internat. Clin., 2:1 (June) 1932.

TABLE 4.—EFFECT OF FEEDING DIET LOW IN CALCIUM, PHOSPHORUS AND VITAMIN D ON THE PRODUCTION OF CARIES*

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	2.50	—	—	+	+
2	2.25	—	—	+	+
3	2.25	—	—	?	+
4	2.25	—	—	+	+
5	2.25	—	39.4	+	—
6	5.00	—	37.6	+	—
7	5.00	—	29.8	+	—
8	5.50	—	32.1	+	+
9	6.00	1.5	46.1	+	+
10	6.00	1.6	42.5	+	+
11	6.00	1.8	31.6	+	+
12	2.00	—	35.5	+	+
13	4.75	1.6	45.9	+	+
14	4.75	2.4	34.1	+	+
15	4.75	3.3	35.5	+	+
16	4.75	2.3	45.9	+	+
17	4.75	3.9	39.9	?	+
18	4.75	3.5	50.0	+	+
19	6.00	—	27.8	+	+
20	4.00	—	49.8	+	+
21	4.00	—	57.8	+	+
22	7.50	1.3	48.4	+	+
23	7.50	2.1	—	+	+
24	7.50	2.2	54.0	+	+
25	7.50	3.0	56.0	+	+
26	2.00	—	—	+	+
27	2.25	—	39.4	+	+
28	2.50	—	31.6	+	+
29	4.50	—	51.8	+	+
30	4.75	4.6	49.7	+	+
31	4.75	3.9	41.1	+	+
32	4.75	3.1	43.5	+	+
33	4.75	—	40.2	+	+
34	4.75	4.8	39.5	+	+
35	2.25	—	—	+	+

*Rats 1 to 25 were fed diet 42 (calcium 0.425 per cent and phosphorus 0.260 per cent); rats 26 to 35, diet 41 (calcium 0.225 per cent and phosphorus 0.260 per cent.)

was directed particularly to these three elements.

The animals chosen for this work were albino and hooded rats. The ease with which large numbers of these animals can be obtained offers advantages, although they are not ideal animals for our purpose for several reasons. For instance, the rat needs very little vitamin C, which is certainly not the case in man. Also, an exclusive diet of milk will not produce rickets in the rat, but frequently does so in the infant; which indicates that a lack of vitamin D has not such serious consequences for the rat as for man. In addition, the teeth in the rat and in man

are not strictly comparable, as the former has no deciduous set. Fortunately, the twelve molars of the rat are sufficiently similar in structure and function to human molars to make them suitable for experimental study. They are of limited growth, possess deep sulci essentially like those found in human molars and are abraded through mastication in a manner similar to the process of attrition in the human being and the pulpal reaction to the invasion of the dentinal tubules closely resembles the reaction of adult human teeth.

Diet 8: Diet normal in calcium and low in phosphorus and vitamin D (calcium content, 0.612 per cent; phosphorus content, 0.240 per cent).

	Per cent
Cornstarch	62.0
Casein (alcohol extracted)	18.0
Crisco (hydrogenated cottonseed oil)	10.0
Yeast (dry powdered)	5.0
Salt mixture (Osborne and Mendel's, without calcium or phosphorus)	2.5
Calcium carbonate	1.5
Sodium chlorid	1.0

Fresh spinach, 100 gm. per animal each week, or machine dried alfalfa, 2 per cent by weight.

Diet 8-A: Diet 8 with 2 per cent of 1-D viosterol added.

Diet 11-A: Normal diet (calcium content, 0.612 per cent; phosphorus content, 0.450 per cent).

	Per cent
Cornstarch	62.0
Casein (alcohol extracted)	18.0
Crisco (hydrogenated cottonseed oil)	10.0
Yeast (dry powdered)	5.0
Salt mixture (Osborne and Mendel's)	4.0

Fig. 6.—Jaw of rat ground mesiodistally showing results of extensive caries with subsequent collapse of coronal portions of teeth.

Diet 1: Normal stock diet (calcium content, 0.793 per cent; phosphorus content, 0.496 per cent).

	Per cent
Whole wheat	60.0
Casein	14.0
Milk powder	10.0
Calcium carbonate	1.2
Sodium chlorid	0.8
Alfalfa	1.0
Butter	8.0
Wheat germ	5.0

Spinach or lettuce, 40 gm. each week per animal; lean meat, 10 gm. each week per animal.

Sodium chlorid 1.0

To this is added machine dried alfalfa leaf meal, 2 per cent, and 1-D viosterol in corn oil, 2 per cent.

Diet 41: Diet low in calcium, phosphorus and vitamin D (calcium content, 0.225 per cent; phosphorus content, 0.260 per cent).

	Per cent
Whole yellow corn (finely ground)	77.9
Wheat gluten	20.6
Calcium carbonate	0.5
Sodium chlorid	1.0

Fig. 7.—Beginning caries of enamel with discoloration in very early stage and unaccompanied as yet by extensive loss of enamel substance.

Diet 42: Diet low in calcium, phosphorus and vitamin D (calcium content, 0.425 per cent; phosphorus content, 0.260 per cent).

	Per cent
Whole yellow corn (finely ground)	77.4
Wheat gluten	20.6
Calcium carbonate	1.0
Sodium chlorid	1.0

Diet 43: Diet normal in calcium (lower limit of normal range) and low in phosphorus and vitamin D (calcium content, 0.625 per cent; phosphorus content, 0.260 per cent).

	Per cent
Whole yellow corn (finely ground)	76.9
Wheat gluten	20.6
Calcium carbonate	1.5
Sodium chlorid	1.0

Diet 43-A: Diet 43 with 2 per cent of 1-D viosterol added.

Fig. 8.—Carious rat molar showing extensive "backward decay" or undermining of enamel. This lesion had commenced at the fundus of the sulcus. A portion of the enamel is in imminent danger of collapse with subsequent wide exposure of dentin.

Diet 44: Diet normal in calcium (upper limit of normal range) and low in phosphorus and vitamin D (calcium content, 0.825 per cent; phosphorus content, 0.260 per cent).

	Per cent
Whole yellow corn (finely ground)	76.4
Wheat gluten	20.6
Calcium carbonate	2.0
Sodium chlorid	1.0

Diet 45: Diet normal in calcium and low in phosphorus and vitamin D, with added vitamins A, B_1, B_2, C and E (calcium content, 0.630 per cent; phosphorus content, 0.284 per cent).

	Per cent
Whole yellow corn (finely ground)	72.5
Wheat gluten	20.0
Calcium carbonate	1.5
Sodium chlorid	1.0
Wheat germ	4.0
Alfalfa (machine dried)	1.0

Tomato juice, 2 c.c. daily per animal.

Diet 45-A: Diet 45 with 2 per cent 1-D viosterol added.

Diet 46: Diet normal in calcium and phosphorus and low in vitamin D (calcium content, 0.625 per cent; posphorus content, 0.483 per cent).

	Per cent
Whole yellow corn (finely ground)	76.0
Wheat gluten	20.0
Calcium carbonate	1.5
Sodium chlorid	1.0
Sodium pyrophosphate $Na_4P_2O_7.10H_2O$	1.5

Diets 1 and 11-A are normal diets. Diet 8 contains protein of high biologic value and plenty of minerals, with the exception of phosphorus. This diet is also low in vitamin D. In Diet 8-A, the deficiency of vitamin D was corrected. Diets 41, 42, 43, 43-A, 44, 45, 45-A and 46 are modifications of Steenbock's rachitogenic diet,[36] which does not contain an optimal quantity of minerals and vitamins, and whose proteins are not of high biologic value. Variations were made in this basic diet by a change in the concentration of calcium and phosphorus and by the addition of machine-dried alfalfa leaf meal, wheat germ and tomato juice. The last three materials add vitamins A, B_1, B_2, C and E and minerals to the diet.

Table 5.—Effect on Production of Caries of Adding Phosphorus to Diet Low in Phosphorus and Vitamin D (Diet 43). (Diet 46 [Calcium 0.625 Per Cent and Phosphorus 0.483 Per Cent].)

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	2.75	—	49.8	o	o
2	6.00	1.6	54.6	o	o
3	6.00	3.1	56.6	?	+
4	6.00	3.4	55.6	o	o
5	6.00	2.6	56.2	o	+
6	6.00	3.3	—	o	—
7	6.00	2.2	48.5	o	?
8	5.50	—	—	o	o

Whole grains obtained from the milling companies and then ground in the laboratory were used. This is important because, from experience, we have found that one is not certain of receiving whole grains if they are ground by the milling companies. All diets were finally ground three times in a "Hobart" mill and care

36. Steenbock, H., and Black, A.: J. Biol. Chem., 64:263 (June) 1925.

was taken to insure adequate mixing of the different ingredients. The 1-D viosterol has a vitamin D potency equivalent to that of Steenbock's standard cod liver oil. It was added in the proper proportions to a quantity of the diet sufficient to last only two or three days in order to avoid possible loss through oxidation, which might occur if it were added to a large quantity of the diet and allowed to stand for a long period. The animals were placed on the experimental diets at 4 weeks of age and were kept in roomy cages which had coarse wire mesh bottoms. Any food that was spilt from the food cups was collected and weighed in order to keep the food records as accurately as possible. No cod liver oil was added to the stock diet of the breeding rats, as it is well recognized that this produces a vitamin D effect in the young which lasts for some time.

TABLE 6.—EFFECT ON PRODUCTION OF CARIES OF ADDING VITAMIN D TO DIET LOW IN PHOSPHORUS AND VITAMIN D (DIET 43). (DIET 43-A [CALCIUM 0.625 PER CENT AND PHOSPHORUS 0.260 PER CENT]; DURATION OF DIET, 2 TO 5 MONTHS.)

Rat	Period on Diet Months	Ash in Bone Per Cent	Macroscopic Caries	Microscopic Caries
1	2.5	42.4	o	o
2	3.0	—	?	o
3	2.5	41.2	o	o
4	3.0	—	o	o
5	5.0	—	o	o
6	5.0	—	o	o
7	3.5	54.0	?	+
8	3.5	55.4	?	+
9	4.5	51.2	+	+
10	3.0	46.5	+	+
11	3.0	—	o	+
12	3.5	54.3	o	+
13	4.5	58.5	+	+
14	3.0	49.4	+	+
15	2.5	49.6	+	+
16	3.5	56.1	?	+
17	4.0	49.0	?	+
18	4.5	—	o	+
19	3.5	—	+	+
Total 19				
Average age	3.5			

After the animals had been fed the diets for stated intervals, they were anesthetized with ether and, in some instances, blood was taken for the determination of the inorganic phosphorus in the whole blood by the method of Fiske and Subbarow.[37] The percentage of ash in the fat-free tibia and fibula was also determined, using the Bethke, Steenbock and Nelson technic.[38]

A study of the oral tissues of the animals was made, following three general procedures: (1) gross study of the teeth and jaws with the aid of the binocular dissecting microscope; (2) study of ground undecalcified sections, stained and unstained, of the teeth and the alveolar bone, including the imbedding method (kollolith or balsam, which retain the soft tissues *in situ*); (3) study of decalcified and serially mounted sections using a variety of stains for tissue or bacterial demonstration.

MACROSCOPIC EXAMINATION

Gross examination revealed lesions of the enamel and dentin (and pulp) which exhibited the characteristics macroscopically of dental caries as seen in the human being. The lesions occurred almost invariably on the occlusal surface, commencing at or near the fundus of the sulci of the crowns. In some cases, the external lesion was small. In others, there was found extensive destruction of a part or of the whole of the crown, exposing the floor of the pulp chamber and the orifices of the root canals. In some instances, weakening of the tooth wall had led to collapse of portions of the crown. Examples of macroscopic caries are shown in Figures 2 and 3, with contrasting normal conditions in Figures 1 and 4.

37. Fiske, C. H., and Subbarow, Y.: J. Biol. Chem., 66:375 (Dec.) 1925.

38. Bethke, R. M.; Steenbock, H., and Nelson, M. T.: J. Biol. Chem., 58:71 (Nov.) 1923.

Fig. 9.—Ground section of rat molar showing in fundus of sulcus invasion of enamel and involvement of dentin with production of defensive "translucent zone" in dentin, appearing as light band. There is a deep sulcus filled with débris; also, on the extreme lower left, a similar lesion affecting the cervical portion of the tooth.

MICROSCOPIC EXAMINATIONS

Ground Sections.—Ground sections again revealed the characteristic phenomena seen in human dental caries. The areas of affected enamel corresponded in location and contour with the areas of affected enamel in human caries where pits, fissures and sulci are attacked. The contours were largely cone shaped, with the base directed toward the pulp and the apex toward the surface of the tooth. Discoloration of the affected enamel corresponded to discoloration of involved enamel in human teeth. Following the penetration of the carious process to the amelodentinal border, secondary caries of enamel, or "backward decay of enamel," was found to occur. This phenomenon, consisting of a lateral spread of the carious process immediately beneath the enamel, commencing at the point of invasion of the dentin, is due largely to the abundant anastomoses of the peripheral ends of the dentinal tubules facilitating the spread of the lesion.

As a result of this condition, not only is the dentin attacked over a wider area leading to shallow mass collapse of the dentin, but likewise the enamel is attacked from the inner side. Thus, as in the human being, the actual size of the involved area may be considerable, while prior to the collapse of the weakened and overhanging enamel, the external opening may be minute. In the ground section, moreover, may be seen the phenomenon known as the "zone of translucency," commonly seen in molar occlusal caries in the human being. This is a defensive reaction consisting of a hypercalcification occurring in the involved dentinal tubules, the purpose of which is to protect the proximal dentin and the pulp. Figures 6 to 9 illustrate ground sections of carious rat molars. Figure 5 illustrates a caries-free jaw for comparison.

Decalcified Sections.—Decalcified sections afforded much further information regarding the processes involved. Since the organic portion of enamel is relatively small (approximately 3 per cent),

the action of the acids which are formed in the carious process is sufficient to disintegrate the enamel. Similarly, in laboratory decalcification, the enamel is in large part disintegrated and lost unless special imbedding processes are employed to maintain *in situ* the delicate organic matrix.

In the case of the dentin, the high percentage of organic material present (approximately 28 per cent) maintains the original form and structure even after decalcification. Disintegration and dissolution of the dentin in the carious process are secondarily brought about through peptonization, accomplished by certain proteolytic types of organisms. Naturally, therefore, laboratory decalcification in the preparation of the specimens for microscopic examination reveals further evidence of the structural changes which occur.

In dentinal caries, the matrix is usually decalcified before the tubules are invaded by bacteria. The sheath of Neumann, which forms the immediate wall of the tubule, becomes thickened, and there is an actual increase in the diameter of the tubule. The softened matrix between the tubules is compressed and with peptonization of this matrix and increase in tubular diameter, these tubules may come into contact. These enlarged and prominent "pipe-stem tubules" are readily observed in the sections.

Micro-organisms invade the tubules and bring about the disintegration of the sheaths of Neumann; which brings neighboring tubules into intimate relationship. The term "liquefaction foci" is applied to broadened zones along the course of the tubules where the intervening walls have been broken down.

With the increase in size of these "liquefaction foci" and coalescence of neighboring foci, there occurs the gradual production of a cavity in which may be found detritus of dentinal origin with bacteria, etc. Where the "backward decay of enamel" has been extensive, and broad areas of dentin become involved, the contour of the carious area is roughly

Fig. 10.—Early carious lesion in dentin of rat molar (decalcified section). The attack has commenced at the fundus of the sulcus. Superficial mass collapse of the dentin and the small number of engorged "pipestem tubules" with bulbous enlargements may be noted.

that of a cone with the apex directed toward the pulp.

A barrier of variable effectiveness is often thrown up by the pulp. This overlies the pulpal extremities of the affected dentinal tubules in the so-called "dead tracts"[39]; i.e., the area of involved dentin in which hypercalcification has not taken place, and this secondary dentin attempts to protect the pulp tissue from peripheral injuries sustained by the primary dentin by means of a nontubular barrier. (Simple extension of primary dentin does not show this barrier.)

Fig. 11.—Advanced stage of caries of dentin in rat molar. There are grossly enlarged "pipestem tubules" and, particularly in the central portion of the picture, extensive coalescence of "liquefaction foci" with collapse of dentin may be seen. The barrier of secondary dentin below the latter area temporarily retards the process. The similarity to the human condition pictured in Figure 12 may be noted.

Figures 10 to 13 are serial sections of decalcified carious teeth showing the process above described. Figure 12 illustrates a case of human dentinal caries which shows the similarity to that of the rat.

Control animals have in no instance exhibited evidence of carious lesions. The possibility of the production of caries-like lesions through splitting of the cusps of rat molars or other trauma, with resultant "holes" of noncarious origin, is eliminated by the careful histologic examination. Such splitting of cusps may be observed to a certain extent in both control and experimental animals, but, in the control animals, has in no case been associated with dental caries.

COMMENT

The caries which occurred in these rats is essentially comparable to that found in man. When the animals were fed the normal stock diet 1, or the normal diet 11-A, caries was never found, even after a period of eighteen months. In contrast to this, the animals which were given a diet composed of yellow corn, wheat gluten, calcium carbonate and sodium chlorid, a diet which is very low in phosphorus and vitamin

39. Fish, E. W.: Experimental Investigation of Enamel, Dentine and Dental Pulp, London: John Bale Sons and Danielsson, 1932.

D, for two months or more, developed caries in almost every instance. The addition of vitamins A, B_1, B_2, C and E to this diet apparently did not influence in any way the development of caries.

As this diet is also deficient in minerals and high quality proteins, one could not conclude from these experiments that the caries was due entirely to the low phosphorus content and the absence of vitamin D. When the phosphorus level of this diet was brought up to the so-called normal level, caries was prevented in four out of seven animals for periods up to six months. Also, when the phosphorus was left at the original low level, the addition of vitamin D reduced the prevalence of caries, as six of a series of nineteen animals did not develop the disease in periods up to five months.

On examination, only 50 per cent of the animals fed diet 8, which, although low in phosphorus and vitamin D is quite adequate in both proteins and other minerals, showed caries during periods up to thirteen months. When vitamin D was added to this diet, caries did not develop in a single instance during similar periods.

Fig. 12.—Caries of dentin in human tooth showing "pipestem tubules," coalescing "liquefaction foci" and extensive superficial destruction of dentin. Similarity to the condition shown in Figure 11 may be noted.

Fig. 13.—Carious process in rat molar penetrating secondary dentin barrier and leading to necrosis of adjacent pulp tissue. There is extensive surface loss of dentin. Infected tubules leading from the periphery of the dentin at a further point in the serial are seen to penetrate the secondary dentin along the pulpal wall, causing invasion of the pulp.

Calcium was added in varying amounts to give percentages varying from the high normal level of 0.825 per cent to the very low level of 0.225 per cent, but this had no apparent influence on the development of caries.

Other investigations carried on in this laboratory by Dr. Chant Robertson and her co-workers indicate that when the proteins are not of a high grade, or when certain of the vitamins are absent, the resistance to infection and the general health of the animal are impaired. It is quite reasonable, therefore, to consider that the maintenance of normal teeth is dependent primarily on a sufficient supply of phosphorus and vitamin D, but that any other deficiency in the diet which impairs the general health of the animal would accentuate the effect of inadequacy in the supply of phosphorus and vitamin D. It is quite possible, of course, that the consistency of the food might also be a factor in the production of caries in these animals, because the corn diets impacted much more readily than did diet 8. It should be noted that when an adequate amount of phosphorus or vitamin D was added to the diet, which did not alter its consistency in the slightest degree, the development of caries was prevented or delayed.

No relation is evident between the percentage of bone ash and the incidence of caries. The whole blood inorganic phosphorus was low in the animals that developed caries. The blood phosphorus of the animals on the normal stock diet 1 and the normal diet 11-A was usually above 5.0 mg. per hundred cubic centimeters of blood. In the older animals, it was sometimes as low as 4.0 mg. and occasionally it even went down to 3.5 mg. A rather unexpected result was seen in the animals receiving added phosphorus (Table 5), which, although they did not develop caries, still showed a low blood phosphorus. The same low blood phosphorus was found in the ani-

TABLE 7.—EFFECT ON PRODUCTION OF CARIES OF ADDING VITAMIN D TO DIET LOW IN PHOSPHORUS AND VITAMIN D (DIET 43). (DIET 43-A [CALCIUM 0.625 PER CENT AND PHOSPHORUS 0.260 PER CENT]; DURATION OF DIET, OVER 5 MONTHS.)

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	6.5	2.9	55.8	+	+
2	6.5	3.5	55.4	+	—
3	6.5	3.4	55.7	+	—
4	6.5	—	43.8	+	+
5	6.5	—	55.9	+	—
6	7.5	3.0	58.1	+	+
7	7.5	3.6	58.4	+	+
8	7.5	3.3	59.1	+	+
9	8.0	3.3	—	+	+
10	8.0	3.7	—	+	+
11	8.0	3.7	—	+	—
12	8.0	3.8	—	+	—
13	8.0	4.1	—	+	—
14	8.0	3.5	—	+	—
15	8.0	3.5	—	+	—

mals that were given vitamin D in addition to this diet. Further work will be undertaken on this aspect of the problem.

From our results, it is reasonable to conclude that, in the rat, adequate supplies of phosphorus and vitamin D are factors in the prevention of dental caries. This is essentially in accord with the views expressed by McCollum and his co-workers,[39] who stressed the possible importance of these elements as long ago as 1922. In the rat, it is evident that, of these two elements, the phosphorus is the more important. This is also true in the experimental production of rickets, as this disease cannot be produced in the rat when phosphorus is added to a rachitogenic diet, in spite of a low vitamin D intake. In infants, it is universally recognized that vitamin D is essential for the prevention of rickets in spite of a large phosphorus intake. It is reasonable to expect, therefore, that, in view of the prevalence of caries in individuals who are consuming diets which contain fairly large amounts of phosphorus, the vitamin D factor is of greater importance for the prevention of caries in the human being than it is in the rat.

TABLE 8.—EFFECT ON PRODUCTION OF CARIES OF FEEDING DIET NORMAL IN CALCIUM AND LOW IN PHOSPHORUS AND VITAMIN D. (DIET 8 [CALCIUM 0.612 PER CENT AND PHOSPHORUS 0.240 PER CENT]).

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	5.5	—	53.5	o	+
2	9.5	—	58.7	o	+
3	9.5	—	—	o	?
4	9.5	—	—	o	+
5	6.0	3.0	56.2	o	+
6	6.0	—	55.8	o	o
7	9.5	—	56.1	o	+
8	13.0	2.6	59.0	o	?
9	13.0	—	56.6	o	o
10	6.0	—	—	o	o

TABLE 9.—EFFECT ON PRODUCTION OF CARIES OF ADDING VITAMIN D TO DIET LOW IN PHOSPHORUS AND VITAMIN D (DIET 8). (DIET 8-A [CALCIUM 0.612 PER CENT AND PHOSPHORUS 0.240 PER CENT]).

Rat	Period on Diet Months	Blood Inorganic Phosphorus Mg.	Ash in Bones Per Cent	Macroscopic Caries	Microscopic Caries
1	6	5.0	58.6	o	o
2	13	4.4	59.8	o	o
3	13	4.4	59.7	o	o
4	13	3.9	62.1	o	o
5	10	—	—	o	o
6	8	—	—	o	o
7	8	—	—	o	o
8	8	—	—	o	o
9	8	4.7	59.7	o	o

39. Footnotes 19 and 26.

It is realized fully that the value of this work lies in its application to man. Accordingly, a total of approximately 350 children on diets containing varying amounts of calcium, phosphorus and vitamin D have been observed during the past year in four institutions with the aid of a group of dentists of Toronto. A most meticulous dental examination was carried out at the beginning of the investigation and will be repeated at its conclusion. During the period of the investigation, the children have been divided into three groups as follows: (1) the control group, in which no change has been made in the diet; (2) a group who have been given additional vitamin D, and (3) a group who have been given both additional vitamin D and phosphorus.

An interim examination has recently been made of the children in groups 1 and 2. To insure an unbiased interpretation of results, operators in examining the children were unaware of the groups in which the children were classified until all the records were completed. This examination showed, in those children who had been given additional vitamin D, a definite trend toward a lessened incidence of caries as compared to those who had eaten only the usual normal diet. Moreover, the children with added vitamin D showed that previously existing cavities had been largely arrested. In certain of these arrested cases, a definite hardening of the cavity walls was apparent. The general tone of the gingivae and of the mucous membrane of the mouth of these children showed a definite improvement when compared with the gingivae and mucous membrane of those children who had not been given the additional supply of vitamin D.

SUMMARY

1. No evidence of dental caries was found in 365 animals fed the normal diets for periods of from two to eighteen months.

2. Seventy out of seventy-one animals fed a diet low in phosphorus and vitamin D for periods of from two to seven months showed dental caries. This diet, composed largely of corn and wheat gluten, is also low in other minerals and vitamins, and the proteins are not of a good quality.

3. The addition of vitamins A, B_1, B_2, C and E to this diet apparently did not have any effect on the development of dental caries.

4. The addition of phosphorus to this diet prevented the development of dental caries in four out of seven rats when fed for periods of from two and three-quarters to six months.

5. The addition of vitamin D to this diet in the form of viosterol prevented the development of dental caries in six out of nineteen rats when fed for periods of two and one-half to five months.

6. Ten animals were fed a diet composed of cornstarch, casein, vegetable fat (crisco) and yeast, with added minerals and vitamins for periods of from five and one-half to thirteen months. This diet, although low in phosphorus and vitamin D, is adequate in other respects. Dental caries developed in five of these animals.

7. Nine animals fed this diet with the addition of vitamin D in the form of viosterol for periods of from six to thirteen months did not show evidences of dental caries in any instance.

8. The amount of calcium in the diet apparently had no influence on the development of dental caries.

9. A preliminary examination of a number of children under observation indicates the importance of an adequate supply of vitamin D for the prevention of dental caries.

CONCLUSIONS

1. Dental caries can be produced and prevented in laboratory animals at will by dietary means.

2. In the rat, an adequate supply of phosphorus is an important factor in the prevention of dental caries.

3. In the rat, an adequate supply of vitamin D may prevent or delay the onset of dental caries. In this animal, the role of vitamin D is not of such great importance as that of phosphorus.

4. In man, the addition of vitamin D to diets previously considered adequate in all respects, including phosphorus intake, is an important factor in the prevention of dental caries.

WEST CHINA

TRANSFER

February 15, 1933.

Dr. R. Gordon Agnew
West China Union University
Chengtu, Szechwan, China

My dear Dr. Agnew:

Under separate cover we are mailing you a copy of the February 4th issue of the Literary Digest. It is not often that our China missionaries get their pictures in the Digest, so you will be interested in the write up on page 24.

Since the Luncheon on December 6th, the dental research you and Mrs. Agnew have been carrying on has been receiving very wide and very friendly publicity throughout the country. I believe that every precaution has been taken to avoid over-statements or mis-statements that might create adverse criticism within the dental profession itself. We all recognise that nothing so quickly arouses the suspicion and antagonism of medical men as any ambitious claims of new discovery or significant progress. There have been a few rather chilly comments here and there, such as those referred to on page 25, but they have been quite rare, and I believe have hot been at all serious.

Our West China luncheon not only has given the University some very friendly publicity, but has also shown us the limitless possibilities contained in this general type of publicity. Practically everyone of our colleges in China is carrying on important and fascinating pieces of educational and scientific work which would arouse wide-spread interest and generous support throughout America, if we could only find ways to disseminate this information in a constructive and interesting way.

I am enclosing herewith a note of inquiry that recently reached us. I do not know whether or not you will think it worthwhile to send any reply.

I hope that you and your family have now safely reached Chengtu, and are taking up again very happily your work on the West China campus.

Very cordially yours,

B A GARSIDE

BAG:PW
Enc.

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Two Missionaries Make a Dental Discovery

TOOTH-DECAY CAN BE WARDED OFF by vitamin D and phosphorus in the diet.

This is the conclusion of a research lasting ten years, made by Dr. and Mrs. R. Gordon Agnew, of West China Union University.

These two medical missionaries announced their discovery at a luncheon given in New York by the Board of Governors of the university.

Says the author of a report in the Chicago *Tribune:*

"Their announcement of the final step in ten years' research, experiments on 350 children, was hailed by Dr. E. V. McCollum of Johns Hopkins University, one of the world's foremost dieticians, as a 'milestone in scientific progress.'

"Their work, he said, eliminates confusion about the diet needed for teeth. Vitamin D comes from sunshine and cod-liver oil, or their substitutes. The phosphorus foods in order of their richness are egg yolk, milk, meats, leafy vegetables, and the seeds, grains, roots, and tubers.

They Can Produce and Prevent Dental Decay at Will

Dr. and Mrs. R. Gordon Agnew, of the West China Union University, who made the dental discovery.

"The saliva, said Dr. McCollum, is probably the means of tooth protection through phosphorus it receives from the blood.

"Dr. Agnew said they found their clue in analysis of 3,000 diets of Chinese and Tibetans who have better teeth than Americans. They returned to the University of Toronto for scientific investigation, and were able to cause 100 per cent. decay in teeth of rats by diet alone.

"Finally, this year, the feeding of children began. Decay was not only prevented among those with the rich phosphorus vitamin D balance, but decay already started was stopt.

"'The significant fact,' said Dr. McCollum, 'is that the Agnews for the first time, consciously and under scientific control, have succeeded in producing and preventing dental caries [decay] practically at will, and to a degree approaching 100 per cent. Their work gives further strength to the conclusion that dental caries can be largely, perhaps wholly, prevented by correct eating.

"'The Agnew work enables us to dispose of certain misconceptions more or less widely held in the past. The popular belief that tooth decay is due to impaction and fermentation of food within fissures of the teeth is doubtless true in certain cases. We will probably never be able to do without the toothbrush.

"'One of the oldest, most widely held, and most erroneous popular beliefs has been that tooth-decay is largely due to eating too much sugar and other sweets. Altho sugar itself does not decay teeth, sweet-eating contributes indirectly, because sugar satiates the appetite so quickly that a lack of the more essential food elements usually results. The Agnews appear to have conclusively demonstrated this truth in the experimental research they have just reported.

"'Another theory that gained wide acceptance is that decay is caused by a deficiency of vitamin C. It has nothing to do with the primary cause of dental caries.

"'The inference to be drawn from this research work is that if we eat an adequate supply of vitamin D, drink plenty of milk, and eat plenty of vegetables and other foods rich in phosphorus, nearly all of us can avoid dental caries.'

"Asked after the luncheon to suggest a specific diet, Dr. McCollum specified a quart of milk daily, eggs several times a week, a leafy vegetable at least once a day, and a salad twice a day, and 'after then anything you like.'"

The Atlanta *Journal* adds:

"It is hardly to be hoped that in our own day this newly won knowledge will transform the mouths of the world into smiling rows of Orient pearls; but if it does no more than help the school children of America, 95 per cent of whom are said to suffer from dental caries, we should call Dr. Agnew blessed, and build a monument to vitamin D."

BUT the Brooklyn *Eagle* injects the following note of pessimism:

"When one is writhing in agony from an abscessed molar, it isn't a bit soothing to be told that if he had eaten substances containing vitamin D, for a few years back, all his teeth would be in good condition. Vitamin D may save his wife and his children. What he demands is a quick surcease of pain. The dentist must get into action at once. Also, he is in no mood to stand any haggling about what the dentist's bill will be. Often he does not expect to pay it too promptly.

"On the whole we imagine the dentists are wiser to compromise if they can, and surrender if they must. Perhaps socialized dentistry will do more to make good digestion wait on appetite than most of us can now imagine."

How Driven Snow Cuts

HARD, dry snow driven by the wind is as effective an agency in wearing away objects exposed to it as is the sand of windy deserts.

Striking examples are seen on the borders of the Antarctic continent, which include the windiest known regions on the globe.

Sir Douglas Mawson tells in an account of his recent Antarctic expedition of finding in Adélie Land a hut built by his expedition of twenty years before. He says, as quoted by Charles Fitzhugh Talman in his Science Service feature, *Why the Weather?* (Washington):

"The exposed wood of the hut and all the wooden objects were found to be deeply scored by the snow blast, resulting in hard and soft tissues standing in singular relief. The fully exposed Oregon boards have been thus reduced in thickness by the snow abrasion in twenty years by quite half an inch."

In the narrative of his earlier expedition he writes:

"The abrasion effects produced by the impact of the snow particles were astonishing. Pillars of ice were cut through in a few days, rope was frayed, and metal polished. Some rusty dog chains exposed to it a few days had a definite sheen. A deal box was handsomely marked, the hard, knotty fibers being only slightly attacked, while the softer, pithy laminæ were corroded to a depth of one-eighth of an inch."

Dental Press on the Agnew Find

INQUIRY AMONG THE DENTAL JOURNALS reveals the fact that, while the Agnews' discovery may be a "milestone," it is only one, and there have been earlier milestones along the same path.

Indeed, Dr. Agnew himself is anxious that their work should not be overstrest, and in a conversation with Dr. Charles Nelson Johnson, editor of *The Journal of the American Dental Association* (Chicago), he voiced his regret that some newspapers have printed misleading and sensational accounts of it. Dr. Johnson is publishing the full report, by Dr. and Mrs. Agnew and Dr. F. F. Tisdall, in the February issue of his journal. Dr. Johnson's view is that the Agnews have done "a creditable piece of work," but one that is "nothing revolutionary."

The Agnews' report gives due credit to earlier workers in this field from 1917 to date, and, after detailed description of the experiments, gives these "conclusions":

"1. Dental caries can be produced and prevented in laboratory animals at will by dietary means.

"2. In the rat, an adequate supply of phosphorus is an important factor in the prevention of dental caries.

"3. In the rat, an adequate supply of vitamin D may prevent or delay the onset of dental caries. In this animal, the rôle of vitamin D is not of such great importance as that of phosphorus.

"4. In man, the addition of vitamin D to diets previously considered adequate in all respects, including phosphorus intake, is an important factor in the prevention of dental caries."

IT happens that a paper by Dr. Johnson, read before a dental society in October, appears in the February issue of *Dental Items of Interest* (New York), in which he treats the effect of diet on the teeth. He says:

"I do not say that diet does not, or can not, affect profoundly the tendency to decay; all I say is that, if it does affect this tendency, it is through the medium of changing the environment of the teeth rather than by changing the structure of the teeth; and in this there is a vast difference. The approach to the problem is almost entirely different, and the vision is concentrated in another direction. When the time comes that we shall have fuller light on the subject, I venture the prediction that we shall see less concentration on vitamin this, and vitamin that, as changing tooth tissue. We shall seek more assiduously for the thing that is happening in the secretions of the mouth, and the agencies that are exerting an influence from without inward, rather than from within outward."

Dr. George Wood Clapp, former editor of *The Dental Digest*, makes this comment by phone:

"I am not trying to belittle the work being done by Dr. Agnew, but there is just as important work going on right here in New York. Vitamin D, while valuable, is insufficient unless combined with vitamins A, B, and C; phosphorus, too much, or out of balance, or lacking in the diet, is harmful rather than helpful. The thing to guard against is playing up the fact that these are new discoveries. They have been known a long, long time."

Dr. Edward J. Ryan, present editor of our dental namesake, stresses the previous work done in this field by Dr. W. A. Price, of Cleveland. Dr. Price's work is given credit by the Agnews in their paper mentioned above.

Family With Self-Bobbing Hair

AN UNMISTAKABLY WHITE FAMILY in Norway has had for generations a considerable proportion of members with hair as kinky as a Negro's.

Moreover—believe it or not—this hair bobs itself; for each hair breaks off after reaching a length of two or three inches.

This freakish family is described in *The Journal of Heredity* (Washington) by Otto L. Mohr, of the Anatomical Institute of Oslo University, who believes that the peculiarity arose spontaneously over a century ago. He writes:

Courtesy of *The Journal of Heredity* (Washington, D. C.)

"Any Intermixture of Negro Blood May Be Safely Excluded"

"After a popular lecture on heredity for teachers, one of the lady attendants came to show me her very peculiar 'woolly' type of hair, which was inherited within her family. She provided me with a rich material of pedigree data, and later also with numerous photographs of affected and normal members of the family. One of her relatives, Rector A. D. Danielson, of Hornnes High School, who is himself typically woolly-haired, has collected a remarkably complete and detailed family record. He had, in fact, published a pedigree of his own family as an illustration of inheritance, in connection with a popular lecture.

"The character is so striking and the data on its hereditary type so clear that it deserves to be put on record.

"The woolly character is very constant in appearance. The hair is strikingly curled or frizzled, not unlike Negro hair, a fact which makes it natural that family members frequently have discust whether an intermixture of Negro blood in the remote ancestry might possibly account for their peculiar hair type. The hairs of the head are densely implanted.

"In spite of a very good hair growth, the hair never gets long, due to spontaneous breaking of all the hairs when they attain a certain length.

"Before bobbed hair became a fashion among the ladies, woolly-haired female members of the family were much bothered because they could not arrange their abnormally short, strange-looking hair in a way that freed them from annoying inquisitiveness in others. The dense curling is also apt to make the hairs entangled so that combing is difficult. The abnormal shortness is analogous to the permanent shortness of the hair in the Negro, Negrito, Melanesian, Bushman, Hottentot, and Papuan races.

"Any intermixture of Negro blood may be safely excluded. Not only is it apparent from the pedigree data covering seven generations that the family is of Norwegian farmers' descent, but the clear 'Nordic' type of the family members also excludes any assumption of distant race crossing. Even nowadays, with the highly developed means of communication, a Negro is

practically never seen in Norway. And the occurrence of a Negro-white cross more than seven generations back is, for social and other reasons, so improbable that it may safely be left out of account. Such an assumption is also ruled out by the woolly character itself, since this character is remarkably constant through succeeding generations, while the same is not true of the hair characters of the woolly-haired races, which appear modified in succeeding hybrid generations.

"We arrive, accordingly, at the conclusion that a hair character which in main features parallels those present in the ulotrichous races must have occurred in a European stock as the result of an independent mutation."

Auto Accidents Declining

THE YEAR 1932 IS THE FIRST in motor-car history to show a decline in the number of traffic fatalities.

Progress in this direction is not confined to the United States alone.

England, France, Germany, and Italy also look forward to flattering results when the record for the year finally is tallied. Says William Ullman in his Feature Service (Washington):

"Preliminary estimates place the total of traffic fatalities in the United States between 30,000 and 31,000, a decline of approximately 12 per cent. from the 34,000 high-water mark set in 1931. An excellent record during the months of peak traffic in England is counted upon to effect a 6 to 8 per cent. reduction in that country's fatality record. Similar reductions in the other major motoring nations are expected, with an average decline of from 8 to 10 per cent.

"The dominant factor in the safety situation is the decline in motor-vehicle use, reflected in a drop in gasoline consumption. This, however, is off but approximately 5 per cent. from the year of record-breaking travel, 1931, while the decline in accidents is nearly twice that figure. The circumstance indicates to motor-vehicle authorities that other factors are to be credited with a share of the progress.

"One of these was the retirement from service of a number of the least mechanically safe vehicles. In the United States, Germany, and France the number of automobiles licensed for the year was smaller than in 1931. While some of these were in excellent condition, the majority necessitated expensive overhauling. Unable to stand the expense, their owners simply failed to register them.

"To the motorists of England must be given credit for confuting their critics to the greatest degree during the year. The beginning of the year in English motoring was marked by the removal of the arbitrary maximum-speed limit on the open road. During the first three months, an interval in which accident records were closely watched, the record as compared with 1931 became black indeed. It resulted in a loud clamor for a restoration of the speed-limit law, to the removal of which the entire increase in fatalities was attributed.

"The restriction, of course, was not reimposed, and the chances for its being reestablished have been made even more remote by the consistent betterment of the accident record during the succeeding interval."

ANALYSIS of the mishap tabulations for the year reveals that trends with respect to certain types of accidents remained much the same as in previous years. Congested areas still retained their lead, but the margin continued to decline. More recognition by the driving public that the chances of mishaps are greater in heavy traffic, and improved methods of vehicle and pedestrian control, are credited with the improvement here. Mr. Ullman continues:

"According to the records of the National Safety First Association of England, comparable to the National Safety Council in the United States, London's traffic safety standard was higher than in 1931, while that of rural districts fell.

"Much the same situation prevails in the United States. It is ascribed in part to the fact that open highway speeds are higher, with the result that accidents are both more numerous and more serious. Another cause contributing to the less favorable showing of the small-town and rural areas in both America and in Europe is the reduction in road maintenance due to the economic pressure on public treasuries.

"Road construction and maintenance came to a virtual halt in England and Continental countries during the year just closed.

"Some figures that may be surprizing to American motorists are revealed in the international accident study. They show that despite its tremendous registration of motor-vehicles, approximately 70 per cent. of the world total, the United States has fewer cars per mile of highway than England. The ratio in England is 12.7 vehicles to every mile of road. In this country it is only 8.8; in Germany 6.3; and in France 3.9.

"While not susceptible to having their values accurately established, there are other contributing causes to the better safety record of motordom generally.

"One of these, which indicates a greater degree of caution in driving, is the smaller number of arrests and fines for traffic misdemeanors. That this is due to more wide-spread law observance rather than to diminished effort on the part of enforcement officials is the statement of traffic authorities. As a matter of fact, England last year for the first time established special traffic police forces, motorized squads concentrating their attention upon this particular class of law violators.

"Another circumstance contributing to the present improvement in motordom's safety record is the intensity and cohesion given to safety-education campaigns. In the United States motor-vehicle officials have received the cooperation in these continuing drives not only from the motor-car industry but from insurance underwriters, gasoline refiners, and every other agency identified with highway transportation. Much the same character of close-knit campaign is being carried on in England, France, and Italy.

"The effect of this constant cooperative campaign has been to make the individual more aware of his personal responsibility in the creation of traffic safety, in the opinion of those identified with it. That, in final analysis, is held to be the only hopeful solution of the entire problem.

"In analyzing the factors that have resulted in motordom's best modern safety record, authorities are of the opinion that most of them are of a positive quality and that, as such, they will continue to exercise a favorable influence."

Nosebleed: Harmless and Otherwise

CONSIDER THE BOY BLEEDING at the nose, drop by drop.

He is holding his head up and backward, so that his shirt will not be covered with red spots.

Now suppose the doctor should whisper to him the word "epistaxis"— a formidable Greek term for his ailment.

"Please," the boy would reply, "put your bunch of keys down my back."

Just a popular remedy. Here is what "Dr. Gamma" says about it in *Gringoire* (Paris):

"It is a popular remedy of the kind that are older than the science of medicine itself. It is moreover a remedy which the science of medicine accepts to-day.

"For how does medicine account for the fact that some children sometimes bleed from the nose without any apparent reason? Just 'reflex vaso-dilatation' [enlargement of the blood-vessels].

"The coldness of the metal precipitates a constriction acting against the dilatation, extending possibly to the mucous membrane of the nose.

"The explanation is as good as the remedy, for the hemorrhage stops spontaneously. The process could be facilitated by pinching the end of the nose."

ODD, just the same, that children should bleed at the nose without any way of finding out why!

A reflex, we are told—a reflex which may be due to the fact that the child is entering its teens—for this epistaxis is often present at such a period. Says the doctor:

"Sometimes these little hemorrhages indicate the possibility of typhoid fever; sometimes they point to an inadequacy of the liver.

"Such nose bleedings, if prolonged or repeated, must weaken the child, render it anemic. If prolonged, there is a possibility of hemophilia—a delay of blood-coagulation sometimes lasting ten or twelve hours.

"It is well to have warning of this in case an operation should ever become necessary. Measurement of the coagulation time of the blood is not difficult.

"In this case, to stop nosebleed the nostril is plugged with cotton saturated with serum.

March 24, 1939

Dr. Gordon Agnew
West China Union University
Chengtu, Szechwan, China

Dear Gordon:

You probably will have heard before this letter reaches you of the plan of the Missionary Education Movement to secure first-class moving pictures from West China for educational purposes in this country. I understand that Dr. De Sourd is writing you in detail about what is planned, but I should like to add to his letter that when I was called into conference and made a member of the interdenominational committee, which is cooperating with the Harmon Foundation, I immediately thought of you as one of the men best qualified in Chengtu to take part in this project. I am hoping that you may find it possible to help in making it a success.

We are in very serious need of good educational films in this country. What we already have is, for the most part, so amateurish as to be almost useless.

I never heard from you whether or not the dental supplies which I bought for you in Hongkong ever arrived. I hope they did. Also, how about the other personal matters which you asked me to take charge of - I mean the stationery and what not which you asked me to buy in Hongkong. If the things did not arrive in good condition, I would appreciate your letting me know so that I can make good the loss from this country.

Please give my best regards to Mrs. Agnew. I hope to be hearing from you some time soon.

Sincerely yours,

Oliver J. Caldwell

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53 Turner Road,
Toronto, Canada,
January 18, 1942

Miss Helen K. Stevens,
American Bureau for Medical Aid to China,
New York City.

Dear Miss Stevens:

I am enclosing herewith a brief summary of the dental situation in China, and an outline of possible programs of expansion to meet the tremendous need which exists.

As I have indicated, any program which would become official would, of course, need the approval of the University, and, in the case of radical academic changes, would need the sanction of the local Board of Directors, the Board of Founders, (Associated Boards for Christian Colleges in China), and the Department of Education of the Chinese Government.

It is extremely difficult, if not unwise, to estimate, from America, costs of the suggested plans -------except in broadest approximation. I shall be in a much better position to estimate costs when (I hope) I shall have reached the East again and shall have had an opportunity to check on the rapidly changing economic situation, especially as to salaries of Chinese teachers, transportation costs and local prices, etc. I shall give you further statement on the detailed involvements of the proposed plans, and, if you wish, shall attempt to approximate costs.

Since the U. C. R. project division is also interested in the possibilities of a dental expansion program (Mr. Hedrick had raised the question some time ago), and since China Colleges are naturally related to such developments in one of their own institutions, I presume, of course, that any project undertaken would be in fullest collaboration with them.

I can voice with certainty the deep appreciation of the Chinese people for your interest and concern in this urgent need.

Cordially yours,

R. Gordon Agnew

C H I N A - D E N T A L E D U C A T I O N A L P R O G R A M

1) - Historical - Dental education in China has centered almost entirely in the West China Union University. There was a short-lived attempt in Peking some years ago; and, just a short time before the Japanese invasion of Nanking, a dental school had opened there in connection with the Central University. The Central University school was invited by the West China Union University to come to Chengtu; this it did, along with other refugee institutions, and, until recently, it has carried on its work in affiliation with, and assisted by, the West China Union University.

Dental education began in Chengtu in 1914, as a department in the University School of Medicine; in 1918 a separate Faculty of Dentistry was created; and in 1929 the Faculty of Medicine and the Faculty of Dentistr joined to form the College of Medicine and Dentistry. The dental curriculum, like that in medicine, requires seven years' work ; but prerequisite educational standards vary somewhat from those in America, and the course is approximately equivalent to six years of university work in American institutions. From the beginning, while it was recognized that a large number of practitioners would be ultimately required to meet the widespread dental needs of the country, it was realized that, without a solid foundation of adequately trained men and women, future developments could not ensure the provision of competent diagnostic and therapeutic service. Thus the emphasis, thus far, has been upon the preparation of a necessarily small (because of the limited financial resources of the university) but biologically and technically trained group of high intellectual and technic capacity and of superior character. Graduates now number well over 100, and these men and women have been occupying key positions in clinical work throughout the country. A number have shown marked ability in preclinical and clinical teaching.

2) - Normal Civilian Needs - The contribution which dental graduates have thus far made has amply justified the emphasis upon thorough training. However, in a country of the immense size and population of China, the demand for vastly greater numbers of such biologically trained dentists, and of technical practitioners to work under their direction goes far beyond the capacity of the school, with its present equipment and personnel, to meet. Dental diseases, odontal, periodontal and maxillary, with frequent systemic inter-relationships, are very prevalent in all strata of society, and in all parts of the country. Dental caries affects approximately one-half of the population; and periodontal disease is almost universal in all but the younger age brackets. It would be calamitous to under-estimate, in any public health program for China, the importance of the prevention and therapy of dental diseases.

3) - Academic Needs - (a)- Academic Standards - The Chinese Government is warmly appreciative of the pioneer efforts in the field of Dentistry; it is becoming more and more aware of the significance of dental health; and has under consideration such problems as the registration and control of dental practitioners, the establishment of academic standards, the organization of state-controlled dental services, etc.

The Dental School of the West China Union University has been acting and must continue to act as a Bureau of Standards to safeguard the development of the profession in order to ensure adequate standa of dental public service. To do this, it must be equipped to launch into a wider program, such as above suggested, looking to more adequate care for nation's dentally ill. It must increase the number of fully trained men an women, and must commence, as soon as possible, the training of technical assistants and hygienists. The training of dental nurses, now possible on a small scale only, must be extended and improved. In short, in order to respond to present urgent needs, and to safeguard future standards of practice, in the interests of the people, the Dental School must not only have blueprints offering future solutions to the nation's dental problems, but must take practical and concrete steps toward the fulfillment of such plans.

3)- Academic needs, ctd. -

b)- Demand for Dental Teachers - Furthermore, the Government is now proposing the establishment of dental schools in various parts of the country. This very excellent move forward creates an increasing demand for qualified teachers and administrators. The parent school is convinced that future leadership of schools, as well as of clinical and public health programs, must come from the Chinese themselves; and the Government is naturally and properly looking to this institution and its graduates as its principal source of leaders in dental pedagogy and administration. A not inconsiderable number of graduates have had or are having academic experience on the staff of their alma mater; a few have been abroad; but the demands of dental teaching and organization in areas in China where Dentistry as an organized profession has never existed will be heavy and exacting. There is, therefore, a very real need for postgraduate training especially adapted to the needs of those who will assume academic and administrative leadership in their profession throughout the country.

c)- Need for Professional Postgraduate Courses - In the strictly professional aspects of Dentistry in China there is a growing demand for postgraduate work in several special fields, particularly in 1)-Oral Surgery; 2)-Periodontology and Oral Diagnosis. Postgraduate facilities should be made available at the earliest moment in these fields; and later in such fields as 4)-Orthodontology; 5)-Radiology; ### ((3))- Public Health Dentistry. Present equipment, personnel and budget have been inadequate to permit establishment of these courses.

4)- Special War Needs -

Additional heavy demands upon the dental profession have resulted from the war situation.

a)- Vast numbers of refugees, often destitute, ill, malnourished and in dire need, have come swarming into Free China, thus markedly increasing the pathetically great clinical needs in Medicine and Dentistry.

b)- There is an urgent need for dental services in the military forces. A brief consideration of the great and growing importance of dental service in the military forces of America and of Europe will suggest the seriousness of the situation in China where practically no dental services are available to the enormous numbers of men engaged in military defense of their country. A small beginning has been made in this direction, but only the fringes of the need have been touched as yet.

It is imperative, therefore, that thedental program be expanded to make available more trained men for military work, and to give graduates special training in War Dentistry to fit them for the special demands which are to be met.

In addition to the fully trained diagnosticians and therapists, who must necessarily be limited in number, it would seem inevitable that there be numbers of technically trained men to perform operations of medium difficulty under the direction of competent dentists. It has been suggested that, as a war emergency measure, men who have some knowledge of technical procedures, but who are academically unqualified (such as those who, in considerable numbers practise in the cities and towns of China - the "ia kwan") be examined, and that the best of these be given brief training to fit them for minor but time-consuming operations under such direction as has been outlined

Further, there is need for the training and preparation of male dental nurses, preferably those with some or complete general nursing training, for chair-side and laboratory assistance to the operator above mentioned.

5)- Suggestions regarding a Plan of Expansion-

(Note)- The plans proposed below must be considered as of the nature of tentative suggestions only, inasmuch as any official program would require the approval of the University; and changes involving fundamental academic departures would require sanction of the Board of Founders of the University, the local Board of Directors, and the Department of Education of the Chinese Government.

Plan A -

a)-General-

1)-Increase capacity of present undergraduate course- Present limit- circa twelve graduates per year; increase to twenty-four.

2)- Establish postgraduate courses in
a)- Pedagogy and Administration;
b)- Oral Surgery;
c)- Periodontology & Diagnosis;

3)- Develop present inadequate training for women dental nurses;

b)-War Needs -

1)- Provide special training of graduates in War Dentistry.

2)- Provide special war emergency training of non-qualified practitioners to act as technical assistants to qualified dentists.

3)- Train male nurses as assistants to groups 1) & 2)

Plan B -

a)- As in Plan A.

b)- As in Plan A.

c)- Commence training of new grade of "technical practitioner", to practise under the direction and supervision of fully qualified dentists.

Note - The training of "dental hygienists" may be included under A)-3) or may form a separate item as d) in Plan B.

Suggestions re personnel and equipment requirements of above plans, and tentative budgets to follow.

R. Gordon Agnew

53 Turner Rd.
Toronto
F
JJC. Ack 7/14/42 July 11th.

Dear Oliver -

We have had a letter from Gordon from Chungking. On May 10th he wrote "And now I am in Chungking again. The city is scarred, dilapidated, hot, but bustling with life" - May 11th "To-day it is raining lightly and cool, and it is a relief after the heat of the past weeks in India. As I have said, the city here is busy and full of people. Temporary shops and buildings have been put up everywhere, covering or adjoining great ruined areas. Prices of everything are fantastic, and life here will be a matter of getting along on the barest possible minimum of needs.... At the Agency there are Gordon and Clara Jones and several men who are permanent residents. Bob McClure, Bill Mitchell and Sidney Bailey of the F.A.U. came from Kweiyang on Saturday night. I have just been up to Dai Jia Hang (where

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the Mc Curdys used to live) to consult with Dr. Bachman of the American Bureau for Medical Aid to China; the problems and difficulties at the present time are tremendous. You know of course how highway transportation has been cut off; and you will realize without my going into detail (which I cannot do) how involved and complicated is the present picture. I have got to consult with a great many departments here; and I shall have an extremely busy time. I shall write in as much detail as is possible about developments in connection with supplies, dental project, etc. in my next letter."

Since that time we have had a radiogram from Chengtu, so we know that he is back on the campus again.

Will you please pass on this information to Mr. Evans and to Dr.

Hume, and would it be convenient to send it on to Dr. Beech? I have been laid up a bit and have to take life easily for a time, and it would help me a lot if you could do this for me.

How about the youngest? I am eagerly waiting reports!

Best wishes to you all,

Sincerely

Mary

(Mrs.) R. Gordon Agnew

53 Turner Rd. Ave
Toronto 10/19/42
Oct. 15th

Dear Oliver -

Thanks very much for your letter. I was delighted to hear of the new arrival. How proud you must be of your two!

Dr. William Service, a son of Dr. Charles Service who was one of the founders of the Medical Dental College in Chengtu, is leaving for China very soon. He will likely be in New York on Monday and I have asked him to look you up. He is a fine chap - we have known him since he was a comparatively small boy.

I knew that you would be willing to help him in any way possible. Are typewriters still available through the Board Offices? He mentioned something about needing one and I said I would write you.

Thanks for the booklet which you sent. Would it be possible to get all these that are available? I have been asked to help with the L.S.S. here and I want all the information that I can get. What are available at United China Relief Headquarters?

Sincerely
Mary (Mrs. R.G. Agnew)

53 Turner Rd.
Toronto
Nov. 17/42

Dear Oliver -

Thank you very much for the booklets. I am very glad to have them for several purposes.

We had such a nice letter from Bill Service, saying how kind you had been. He is delighted with his camera and so happy to find you were a camera enthusiast.

You may have heard of Gordon's illness. Our first information was in a radiogram from Gordon himself through Ventura, California. He said there would be a lapse in his letters as he had been ill, but had recovered. Then in a letter from Mrs. McCartney from Chungking to her daughter Mrs. Butts came the first details. At the time of her letter, it was questionable if Gordon might live. However this week a Clipper letter from Gordon gave all the details, and as soon as I can get some copies made, I'll send a copy on to you.

Will you please tell Mr. Evans that Prof. McNeill of Chicago Divinity School will send him $30.00 in the near future. I knew this

noted & c/

was coming when I asked that 11-17-42 20.00 be given to Bill Service, but I am sorry for the delay in letting him know. (These have been rather hectic days for us until we were sure all was well with Gordon). Will you please ask him to keep the remaining 10.00 until further notice? The thirty dollars from Prof. McNeill is for transpatation expenses for lanterns Gordon took with him and I'll arrange with Gordon at the other end about them.

With every good wish to you, your wife and two daughters -

Sincerely

Mary (Agnew)

November 25, 1942

Mrs. Mary Agnew
53 Turner Road
Toronto, Canada

Dear Mary:

Many thanks for your letter which I have been so slow in answering.

I am very much distressed to know that Gordon had been seriously ill. Please let us know as soon as you receive any information concerning his present condition. We understand that several of our staff members in Chengtu have been out of action as a result of various illnesses.

I informed Mr. Evans that brother McNeill would be sending us a check for $30.00 on your behalf. I am sure that this will soon arrive, and I hope that you won't worry about the matter.

I suppose I told you when you were here, that my youngest brother had been decorated for gallantry in action. A few days ago we saw his medal which is a very handsome affair, and received a description of the difficulty for which he was decorated. It seems that he and his best friends attacked 116 Japanese planes in formation, and somehow managed to break them up while shooting down a fair share. We are very proud of him, and I must confess I feel no doubt about the outcome of the war, and I realize that his accomplishments are typical of what our boys are doing in many parts of the world.

I hope you will be visiting New York before long.

Very sincerely yours,

OJC:MM

53 Turner Rd.
Toronto
Jan. 6th. 1943.

Dear Oliver -

I am enclosing a check for Mr. Evans and I'll be very grateful if you'll give it to him to cover the amount he forwarded to Bell Service. There has been a delay in Prof. McNeil's remittance and I apologize for the time that has elapsed. It was a real satisfaction to know that Bill had reached Calcutta safely, so that means that Olin Stockwell will be there safely, too.

We had a Clipper letter and a cable from Gordon two days before Christmas and another letter yesterday. He was busy with music after class hours as usual. The five Universities Choir now has 200 members and they were busy with the Messiah. The broadcasting station is installing micro-phones in the Administration Building and the Gymnasium so they can broadcast programs directly.

As soon as I can copy some of these letters or get someone to do them for me,

I'll send information on to you. Two people offered to do theem for me, but illness and other difficulties have complicated matters.

I hope you'll see Jim Endicott while he is in New York. I think he'll be there for about a month.

We were so grieved to hear of your brother's death but how proud you'll be of him!

My regards to your wife and to the daughters. The wee one will be an added joy and delight!

Any news from Imogene Ward? We had such a nice visit from the Stockwells. Bill Phelps and Joy Wellmott in September.

Sincerely

Mary

Dear

January 9, 1943

Mrs. R. Gordon Agnew
53 Turner Road
Toronto, Canada

Dear Mary:

I was glad to hear from you, and I hope that you find it possible to visit New York before the winter is over, so that we will have the pleasure of seeing you again.

I gave your check to Mr. Evans, and he wishes me to thank you on his behalf. We are always happy to be of service to you and our other Canadian friends, and I hope you will not hesitate to let us know whenever there is anything we can do for you.

Your news of Gordon's music in Chengtu makes me homesick. As you know, I have not been able to do anything at all with music since my return to this country. As a matter of fact, I have only sung once in public since I left Chengtu. The hectic lives we lead are a handicap in the cultivation of any art. Or perhaps I am simply too lazy.

Please let me know where Jim Endicott is staying in New York. We have not heard from him, and although he probably does not remember me, I would very much like to renew his acquaintance. I was most favorably impressed by him when I met him in Chungking.

We have received very little news from Chengtu in recent months, so I am afraid I have nothing of this nature to share with you. With best wishes for this New Year,

Very sincerely yours,

OJC:MM

O. J. Caldwell

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53 Turner Rd
Toronto
Jan. 25th

Dear Oliver -

At last I have Jim Endicott's addres. c/o Prof. McIlroy 324 West 89th St. A message arrived from them to-day, and they were then in New Haven, but planning to be in New York to-morrow (Tuesday). I am sorry that I wasn't able to get this information earlier.

Do you know anything about Madame Chiang's plans? I hope she'll be able to appear at representative places at least on the continent.

I wonder Oliver if you could locate a copy or two of "Young China Sings". I haven't succeeded in getting any here in Toronto. (Gordon organized the committee that checked it before publication (Esther Stockwell was on the committee. too) Gordon took his copies back to China and I want, if possible to get at least one copy. If more

are available. There is a big demand for them, here in Toronto.

Also Oliver I wonder if I could bother you for one more thing — Please don't inconvenience yourself in any way about it. When we were last in New York I remember seeing in a shop not far from 150th — 5th Ave — not more than a block or two away, but I'm not sure of the direction — a Chinese carved picture. They come from South China and I think you'll know the type. I think it is a mixture of cork and bamboo carved. The one I saw was in a bamboo frame. The frame is not important because bamboo type of frames are available here. Have you noticed the shop — and if, by any chance, you have noticed it,

have they, by any further chance, any left?
I hesitate to bother you at all, but
Gordon's brother's hobby is art and he
has taken such delight in the one we
have. Ours was given us by the student
choir before we left Chengtu.

Have had a dose of malaria which
has been keeping me a bit under
but I hope to be completely clear of
it soon.

With sincere personal good
wishes to you all,

Sincerely

Mary

P. S. on page 4

P. S. 4. 1-25

By the way. Oliver, you may be interested in an article of ours in the Journal of the American Dental Association (January). As soon as the reprints come, I'll send you one. It is published concurrently in the January issue of the Canadian Dental Assoc. Journal. It isn't anything new - being the address given in Texas before Gordon went away.

M. (mac) R. V. Agnew

53 Turner Rd.
Toronto
Feb 2, 1943.

Dear Oliver -

Another hurried note to tell you that we had a cable from Gordon from ? but we presume it is from Calcutta, India. The place of origin has been deleted but it reads as follows —

"
Arrived Relief Transportation Business
Remaining Two Three Weeks
If needed telegraph Cooks
Grateful Gifts Service "

Apparently he has contacted Bell Service either in Chungking or Calcutta. A cable came last Thursday saying Bill had reached Chungking.

Thought you'd like to know.

Sincerely Mary (Mrs.) R. G. Agnew

P.S. Endicotts arrived home Sunday morning to find Shirley, their daughter, with scarlet fever! Did you see them in New York? M.

(over)

2-2-43

The telegraph office said the message came from a British Possession so that's the reason for Dadia!

Dulles

February 10, 1943

Mrs. R. G. Agnew
53 Turner Road
Toronto, Canada

Dear Mary:

I have been very remiss in answering your letter of late, but have an excellent excuse. We have been busily engaged in preparing appeals for funds on behalf of the Colleges, including West China. Inasmuch as our program in China depends in a large measure on the securing of these funds, I know you will forgive my procrastination.

To answer your questions in order, I will say that we have tried to discover the nature of Madame Chiang's plans, but so far have had no success. It is my understanding that she is truly a sick woman, and that it may be some time before she will be making any public appearances of any kind. We will be happy to let you know as soon as we receive any more specific information.

Regarding "Young China Sings", I have not the faintest idea where copies can be secured. However, my friend Liu Liang-mo, who is lecturing for United China Relief might be able to tell us. I expect to be seeing him before long, and shall try to secure a copy for you through him.

A few months ago I investigated the possibility of securing some of the carved pictures you mentioned. A shop I visited is two blocks from this office, and is probably as well stocked as any place in the city. I find that they have a number of what I consider very inferior pictures for sale, most of them unframed. The prices range from $.15 for an insignificant piece of carved cork on a piece of paper the size of a postcard, to $5.00 for a larger and better specimen. You can get a fairly adequate example of this type of art for about $2.00. Please let me know is this is what you want. You must remember, however, that these pictures are very inferior compared

to what you have seen in China, and I am not even sure that they were not made in this country.

I am looking forward to seeing your article in the Journal of the American Medical Association. If you have any extra copies please send me two or three at least.

We were sorry to miss the Endicotts on the occasion of their recent visit. It was my fault, because I procrastinated until suddenly I was reminded that they were no longer in town. He, of course, does not remember me, but for several reasons I was anxious to renew his acquaintance.

I am sure it must be a relief to you to know that Gordon is safe, busy, and probably reasonably happy. This long separation must be extremely difficult for you. I hope that there will be a marked turn for the better in the war news, so that your separation will be shorter than you have anticipated.

With best wishes,

Very sincerely yours,

OJC:MM

O. J. Caldwell

53 Turner Road
Toronto. Ont..
May 25th

Dear Oliver -

My apologies for being so long in answering your letter, but these days have been exceedingly busy for me and my correspondence has almost been completely dropped.

As you, no doubt, will have heard Gordon is back again in China. His trip to India was highly successful, and he expected by the end of March that all his supplies would be in China. If you are interested, I'll try and get some copies made of his letters.

Regarding the carved pictures, I'd be so grateful if you'd get one of the five dollar variety. I have an airman friend in New York City at the present time, and if I can get in touch with him, I'll have him call for it. If not, would it be too much trouble to ask you to post it to me. I hope you have an opportunity to meet this chap for he has

been a life-long friend of Gordon's family. His name is Sgt-Pilot Watson.

Mailed separate cover, I am sending 3 copies of the T.A.A.A article.

The news of Grace Manly's death has been a terrific shock. Some of our people here feel that it is just the beginning due to conditions prevalent now in China. What a loss! Father Stockwell put it so well " I don't see how Olen and the rest of us - and China - are going to get along without her, though such a beautiful life as hers can never die, and her work and spirit and influence will go on and on "

How much we are hoping for some adequate help to China! You no doubt of the moving of the Canadian School (Public & High) to India. They couldn't swing the rising costs in China.

With sincere good wishes to you and yours,

Sincerely

Mary

P.S. If Fred Watson is in difficulties will you help him out and I'll settle with you later - when I settle for the other! M.

Dler

June 1, 1945

Mrs. R. Gordon Agnew
53 Turner Road
Toronto, Canada

Dear Mary:

It was pleasant to receive your latest letter, and I hope I will not have to wait so long before hearing from the Agnew's again. I have recently been commissioned a captain in the United States Army, and probably will be in camp by the 1st of August. It is my hope that I shall be able to maintain my contacts with my friends from China, and I hope that you won't forget to write me occasionally.

We would be delighted to receive whatever pertinent information Gordon's letters may contain. We are particularly eager to know if anyone so far has succeeded in transfering supplies overland from India to China.

I am looking forward to meeting your friend Pilot Wilson. We will be happy to do everything we can to make his visit here a success. When I see him, I shall take him with me to pick out one of the wooden pictures. If he is not able to call, I will send it to you by Parcel Post.

We, in this office, are deeply disturbed by recent reports from West China. Conditions appear to have become almost intolerable. We are trying to meet all of their requests for funds, and have been extremely fortunate in the amount of money we have been able to secure for the Colleges this year. You will be interested to know that according to my unofficial calculations, this office, in an 11 months period ending May 31, received approximately $725,000.00 in new funds for our work in China. Money is still coming in, at an unprecedented rate. (that is, exclusive of regular income from Mission Boards endowment and so on.)

We are all waiting for the time when China will receive adequate aid, both military and economic. In the meantime, we can all take part in the encouraging war news coming to us from all the battle fronts.

With best regards,

Please give my regards to Gordon when you write him.

Very sincerely yours,

OJC:MM

O. J. Caldwell

(over)

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P. S. Thank you very much for the reprints of your paper, which I find very impressive. I have placed it in our permanent files, and I shall be grateful if you will send me copies of any other papers you may have available.

OJC

C O P Y -- College of Medicine and Dentistry
Division of Advanced Study and Research in
Dentistry.

(Original returned to Dr. Beech 11/9/43)

Memo for Dr. Beech regarding shipment of dental and medical relief supplies brought from America by R. G. Agnew.

When I left America for China in January, 1942, I took with me a consignment of relief dental and medical supplies for our own institution and for others. These goods were furnished by the 'Medical and Surgical Relief Committee of America' (headquarters- 420 Lexington Avenue, New York City). This organization has nationally located subcommittees which secure contributions of medical and dental supplies and equipment for distribution wherever relief supplies are needed. However, this Committee's functions do not include the transportation of relief goods beyond America. I requested and received funds from the American Bureau for Medical Aid to China to defray transportation costs to China. The original plan was to convey the goods to Rangoon by steamer; from which point I would transport them to China with the aid of Mission (UCCM) trucks (also in my cargo), and of ABMAC trucks awaiting me in Rangoon (one truck and one station-wagon contributed to the W.C.U.U. Hospital).

The attack on Pearl Harbor occurred shortly before my scheduled departure from the Pacific coast, and after the relief supplies had been conveyed to San Francisco through the generosity of a continental trucking company. Passage and transportation of freight were cancelled. Through the China Defense Supplies organization at Washington I secured passage for myself and priority for my freight on a Lease-lend steamer leaving for Rangoon from the Atlantic coast. The trucking company again assisted and carried the goods back across the continent. I sailed on January 30th. We had a skirmish with a submarine in the Atlantic.

While on the ocean Singapore fell; then Rangoon; and the Burma Road was blocked. The ship docked ultimately at Karachi. Since at that time transportation of freight to China was out of the question, the officer commanding the American Army Service of Supply at Karachi offered to receive my shipment, store until transportation facilities were again available, and to ship to East India for me when I so desired. The shipment accordingly was left on that basis at Karachi, and when I had completed other business in India (publicity work at Delhi, investigation of possible India-China cooperation in hospital supplies, etc.,) I proceeded by air to China. I opened negotiations with the Chinese Government to secure priority rating for air transport of the relief supplies. (I had sold the Mission trucks in India; and the hospital trucks had already been taken to Chengtu). Many months passed before priority rating for so large consignment could be secured and much negotiation was necessary. When, finally, arrangements were nearing completion, the U.S. Army was asked to forward the goods to East India, according to the agreement. The offices at Karachi failed to do so; and further, neither I nor my India agents were able to elicit information regarding the consignment.

I then proceeded to India by air, and after several weeks of strenous work put the situation in order. The U.S. Army S.O.S., through errors of subordinates, had appropriated and/or lost a considerable amount of material and had misplaced much of the balance. I succeeded in rounding up the goods and secured from the S.O.S. replacement from Army stocks of as much of the appropriated goods as could be restituted. (The Auth Electric Company case, 108 lbs., sent with me by Dr. Beech was among the appropriated or lost goods). The S.O.S. administration greatly regretted the difficulties which they had caused, and cooperated splendidly in the forwarding of the goods to China - shipping by rail to Assam, and by freight-plane to China. One shipment was flown directly to Chungking from Assam; and from that point the British Air Forces assisted me by trucking the goods to Chengtu. The second large shipment was flown apparently to Kunming and trucked by the American transport system to Chungking. According to a report which I received the truck "fell over a cliff" and the goods were scattered. (Later, many articles when unpacked were found crusted with dried mud from the breaking open of boxes, evidently in a rice-field. However, the

5-8-45

supplies had been collected, repacked and dispatched to Chungking. In August I took the hospital truck to Chungking and brought the Chengtu portion of the shipment to the campus.

The relief goods are meeting a great deal of urgent need in our own institution and in others, since much of the material is unavailable in China at present and is indispensable in efficient clinical and teaching work. In addition to institutional work other uses are being made of the materials, such as, the equipping of the dental team of the WCUU medical and dental emergency expedition to Honan, etc. Instruments and drugs are filling serious gaps in the armamentaria of many departments. The fortified milk products, vitamins, etc., are proving of inestimable value; and have permitted the opening of a nutritional service for indigent patients, especially children, in the University Dental Clinic, as well as meeting needs in general therapeutics and preventive work.

Following the arrival of the relief goods, and recognizing the urgent need for further assistance of this kind in the near future, the ABMAC and UCR Committees in Chungking have voted to support, with funds for transportation, my request to the Medical and Surgical Relief Committee for a further grant of dental and medical supplies. I am writing to this committee with specific requests from institutions, and particularly with regard to supplies necessary for the new National Dental Clinical and Educational Program which is being inaugurated with initial assistance from ABMAC and UCR. I am asking for contribution of supplies totalling 5000 pounds gross. My hope is that the China Defense Supplies will again assist by securing priority rating for these materials on the American-India section of the journey. I shall ask the American Army to again assist in India; and the facilities of the National Health Administration will be available to assist in getting the goods into China, since the National Dental Health Board is, of course, an integral part of the NHA.

I should like to suggest that the Board of Governors express its appreciation to the Medical and Surgical Relief Committee (see address above) for its contribution, and support the request for further assistance to which I have referred above, since the WCUU will benefit materially in such additional grants as may be made, because of its important status in the national dental program.

Further, I would suggest that the Board express its appreciation to ABMAC for supplying transportation funds to cover transportation costs on the goods now in hand; also its appreciation of the allocation, on the field, of funds to cover a second shipment.

Further, I think that it would be advantageous for the Board to communicate with Mr. Harry Price, of the China Defense Supplies, thanking him for the assistance which he and his colleagues rendered in making available transport facilities for the last shipment, and requesting all possible help in securing further shipping space at such time as the second shipment will be ready for dispatch.

Cordially submitted

West China Union University,
Chengtu

September 15, 1943

/s/ R. Gordon Agnew

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5-8-45

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Cordially submitted

/s/ R. Gordon Agnew

West China Union University.
Chengtu

September 15, 1943

TELEGRAPHIC ADDRESS: "HUATA"

WEST CHINA UNION UNIVERSITY

私立華西協合大學

COLLEGE OF MEDICINE AND DENTISTRY
DEAN OF DENTISTRY

May 29th, 1944 CHENGTU, SZECHWAN

Ack 8/11/44 to Julia Wu.

Mr. C. A. Evans
Treasurer
Associated Board's for Christian
College in China
150, Fifth Avenue
New York, U.S.A.

Central Hanover Ck No. 1650

Dear Mr. Evans,

I am sending herewith a check on the Central Hanover Bank and Trust Company for U.S.$1,000.00 purchased from Miss Priest on the Yenching account for the University Dental Unit. Please add this to the funds which you now hold, credited to the School of Dentistry against purchases to be made in America.

Yenching paid Nanking 7/11/44 701.1071

Excuse this brief massage. I had hoped to write more fully regarding the work of the School, but I am just about to leave for Chungking to attend meetings of the National Dental Health Board. At this meeting the next developments in the National Dental Program will be considered. I shall write in full detail when the meeting have been concluded.

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Cordially yours,

R. Gordon Agnew per J. Wu

R. Gordon Agnew
Dean of Dentistry

RGA:JW

Check $1,000.00
Dep. West China
Irving Trust Co.
7/11/44

TELEGRAPHIC ADDRESS "HUAT"

WEST CHINA UNION UNIVERSITY

私立華西協合大學

CHENGTU, SZECHWAN

COLLEGE OF MEDICINE AND DENTISTRY
DEAN OF DENTISTRY

May 29th, 1944

Mr. C. A. Evans
Treasurer
Associated Board's for Christian
College in China
150, Fifth Avenue
New York, U.S.A.

Dear Mr. Evans,

I am sending herewith a check on the Central Hanover Bank and Trust Company for U.S.$1,000.00 purchased from Miss Priest on the lending account for the University Dental Unit. Please add this to the funds which you now hold, credited to the School of Dentistry against purchases to be made in America.

Excuse this brief massage. I had hoped to write more fully regarding the work of the school, but I am just about to leave for Chungking to attend meetings of the National Dental Health Board. At this meeting the next development in the National Dental Program will be considered. I shall write in full detail when the meeting have been concluded.

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私立華西 協合大學

COLLEGE OF MEDICINE AND DENTISTRY
DEAN OF DENTISTRY

CHENGTU, SZECHWAN

Jan. 4th, 1945

ack 7/10/45

Mr. C. A. Evans
Treasurer
Associated Boards for Christian
 Universities in China
150, Fifth Avenue
New York City
U.S.A.

Dear Mr. Evans,

Dep 2/14/45 West China Suspense

Please find enclosed check no. 1635 on the Central Hanover Bank and Trust Company, dated March 31, 1944 for U.S.$1,000.00, signed by Elsie M. Priest and payable on the Yenching account. Please hold this money to the credit of the Division of Advanced Study and Research of the School of Dentistry for the purchase, at a later period, upon instructions from me, of microscopical or related equipment. Note that these are not dental clinic funds and are not available for ordinary purchases of clinical or other equipment.

Wrote to Guterman Dental Supply Co. after talking with them by telephone 1/23/45

Some months ago I wired you asking you to contact the Guterman Dental Equipment Company of New York City and to pay a small bill for dental instruments, the transportation of which had been fully arranged for as soon as payment was made. Confirmation of receipt of the wire by you was subsequently received. These instruments have been very seriously needed and after a long period of waiting and upon receiving information that no payment had yet been made I again wired you asking for your attention to this urgent matter. Since the transportation arrangements assured early and rapid delivery by air all the way, and since nothing has yet arrived I am wondering if payment has not yet been made. If this is so, will you kindly have this matter looked into at once. The Guterman Company will be readily located in the telephone directory.

Thanking you and with cordial personal regards, I am

Sincerely yours,

R. Gordon Agnew

R. Gordon Agnew
Act-Dean of Dentistry

RGA:JW

TELEGRAPHIC ADDRESS "HUATA"

WEST CHINA UNION UNIVERSITY

私立華西 協合大學

COLLEGE OF MEDICINE AND DENTISTRY
DEAN OF DENTISTRY

CHENGTU, SZECHWAN

Jan. 4th, 1945

Mr. C. A. Evans
Treasurer
Associated Boards for Christian
Universities in China
150, Fifth Avenue
New York City
U.S.A.

Dear Mr. Evans,

Please find enclosed check no. 1635 on the Central Hanover Bank and Trust Company, dated March 31, 1944 for U.S.$2,000.00, signed by Elsie M. Priest and payable on the Yenching account. Please hold this money to the credit of the Division of Advanced Study and Research of the School of Dentistry for the purchase, at a later period, upon instructions from me, of microscopical or related equipment. Note that these are not dental clinic funds and are not available for ordinary purchases of clinical or other equipment.

Some months ago I wired you asking you to contact the Gutermann Dental Equipment Company of New York City and to pay a small bill for dental instruments, the transportation of which had been fully arranged for as soon as payment was made. Confirmation of receipt of the wire by you was subsequently received. These instruments have been very seriously needed and after a long period of waiting and upon receiving information that no payment had yet been made I again wired you asking for your attention to this urgent matter. Since the transportation arrangements assured early and rapid delivery by air all the way, and since nothing has yet arrived I am wondering if payment has not yet been made. If this is so, will you kindly have this matter looked into at once. The Gutermann Company will be readily located in the telephone directory.

Thanking you and with cordial personal regards, I am

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Sincerely yours,

R. Gordon Agnew
Act-Dean of Dentistry

RGA:WL

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ENVIRONMENT AND DIET AS THEY AFFECT PERIODONTAL STRUCTURES

By R. GORDON AGNEW, M.Sc., D.D.S., Ph.D., and
MARY CALDWELL AGNEW, M.A.
CHENGTU, SZECHWAN, CHINA

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ENVIRONMENT AND DIET AS THEY AFFECT PERIODONTAL STRUCTURES

By R. Gordon Agnew, M.Sc., D.D.S., Ph.D., and Mary Caldwell Agnew, M.A.,
Chengtu, Szechwan, China

INTRODUCTION

From the physiologic standpoint, findings in the field of nutrition—laboratory, clinical or survey studies—are of significance to the human race regardless of the point of geographic origin of the investigations. However, from the standpoint of the practical solution of food problems, the American investigator who has lived abroad cannot but be impressed and oppressed by the magnitude of the difference between the problems that, on the one hand, face citizens of the American continent, and, on the other hand, face citizens of most of the densely populated areas of the rest of the world.

On the American continent, the problem, for the mass of the people, is that of choosing from a superabundance of food products, gathered (until recently at least) from all parts of the world, those that are most effective in the body economy, eliminating those that, in spite of taste, texture, color or rarity, are found to be ineffective or damaging, directly or indirectly, nutritionally. It is not so simple a matter for many less fortunate peoples. In China, for example, where we have spent many years in teaching and investigation, the problem for the great mass of the population, comprising a quarter of the human race, is that of finding, painfully and laboriously, enough food to sustain life at all. That is the primary, grim problem. For the fortunate minority, the next question may be considered that of finding foods the ingestion of which will prove most conducive to health and optimal functioning of the body. Finally, a third group, very small numerically, may consider the further question of choosing foods that may combine nutritive value and gustatory appeal.

American citizens cannot evade the implications of this situation. Our Chinese colleagues, in scientific studies of this nature, find it almost impossible to conceive of the situations arising in the Western world wherein, upon occasion, an actual curtailment of the available productivity of the soil or of animal husbandry is proposed to or imposed upon the farmer, in order to maintain attractively high prices for the advantage of certain strata of the population, or to harmonize with some short-sighted and self-centered agrarian policy. When such conditions pertain, a hungry world looks on in bewildered consternation and growing resentment.

After several decades of intensive research in clinic and in laboratory, it is now generally accepted that problems of diet and nutrition are of major importance to the dentist who broadly conceives of his work as a health service. This importance is recognizedly great in times of peace; and is obviously even more so in times of war, when suffering and privation attack, as in modern warfare, not only the combatant forces, but

From West China Union University.

Read before the Section on Periodontia at the Eighty-Third Annual Meeting of the American Dental Association, Houston, Texas, October 29, 1941.

also, and to an even greater degree, the helpless non-combatants who are inexorably the victims of war.

It is of pecular interest and significance that in the reports of conditions in England under war economy, an actual improvement of dietary conditions is indicated to have taken place within the last two years. As every one knows, this does not mean that food supplies of all kinds are abundant. Rather, it indicates skilled selection and distribution of foods, careful study, popular education and enlightened cooperation on the part of the citizenry. This is indeed a praiseworthy achievement on the part of nutritional scientists and national leaders, aided by devoted and efficient service from other parts of the Commonwealth and from the United States. England, once known as the "rickety country," has, under scientific leadership, reached new levels when pressed by those prime investigators of progress—crisis and suffering.

However, it must be recognized that behind England stands a great commonwealth of almost limitless food productivity; also the vast resources of the United States.

If we look at other countries at war, countries without such outside resources, we find a very different picture.

In the Far East today, a considerable percentage of the human race faces not simply dietary deficiencies, but actual starvation. In Shanghai, in 1940, 25,000 bodies of men, women and children, dead of starvation and disease, were taken from the streets of that one city. Leaving such reports of actual deaths from starvation, of which there are an appalling number, we find vast nutritional deficiency. Robert Lim, the dynamic head of Chinese Red Cross activities, reports widespread protein and fat starvation, night blindness from avitaminosis, etc. Of these broader nutritional problems, therefore, problems of life and death, of survival as well as of optimal efficiency and longevity, the dentist or periodontist must be sympathetically and keenly aware if he is to assume his share of a world problem comprehensively and effectively.

FADDISM IN NUTRITIONAL INVESTIGATION AND THERAPY

While significant relationships among nutritional states, dietary habits and general and oral health conditions are now widely accepted, it is necessary to recognize that workers in the various branches of applied nutrition have had to pass through, and have still not fully emerged from, periods of faddism and extremism. Hypotheses have arisen, received exuberant endorsement, tottered and fallen; and so sweeping have been many of the claims made for this or that food element or accessory food factor that many observers have criticized the physician or the dentist or the nutritionist for lack of objectivity and balance. One error common to many food theories that have achieved widespread, but short-lived renown has been that, with the radical and highly advertised factor in the proposed nutritional regimen, there has been coupled a food routine balanced and harmonized with the most enlightened contemporary thought in nutritional science. Naturally, since the rational food program prescribed is distinctly superior to that practiced by most persons seeking better health through the new method, a certain degree of improvement is very likely to follow, apart from, or perhaps even in spite of, that advertised factor to which is given most, if not all, of the credit. In other words, more than one variable is introduced into the dietary experiment. A successful issue, therefore, is misleading, and may be wrongly credited to any of the variables introduced.

We are still being told that health can be purchased at the corner drugstore. Many patients have been assured of results that have failed to materialize; and, for many, both within and without the health services, a much more tentative and reserved attitude is needed.

DIETS IN AMERICA UNBALANCED

From the patient work of many investigators and observers, it is obvious that diets in America and in much of the so-called civilized world are far from being balanced according to our best knowledge. Moreover, to a sobering degree, they fail to fall within the latitudes compatible with optimal health.

While it has been demonstrated that the infant without acquired tastes may often instinctively choose foods appropriate to its metabolic needs, such happy coordination is obviously not true of the mass of the nutritionally sophisticated populace, for the majority of whom choice is made on a basis of taste, texture rarity, etc., rather than on a basis of food value and adequacy of balance.

This perversion of choice cannot, in a highly favored area such as North America, be ascribed to economic pressure or food scarcity, as has already been indicated. (A friend of ours stated that his mother, owning a large farm in the Middle West, was receiving in 1935 as much income from government grants made to her in return for her not planting certain foodstuffs as she was making from all of the rest of her farm's produce!)

When we study a people that has, for long centuries, lived very close to the subsistence level, we find conditions that are much more understandable and justifiable—in fact, we may find conditions that are markedly successful from the standpoint of survival value.

SURVIVAL DIETARY ADJUSTMENTS IN CHINA

Such a condition may be found in China, which, with certain significant limitations, has achieved, through several thousand years of observation, of trial and error, a degree of dietary adjustment and a degree of empiric understanding of basic food principles. To be sure, wars, floods and other calamities have, historically, destroyed for a time this adjustment; such, at this time, being actually the case, but, from a racial survival standpoint, 450,000,000 people have adjusted their food habits until a certain degree of "survival stability" has been reached. And, as Adolph[1] points out, this stability has remained apparently more or less unchanged for perhaps a thousand years.

It is fascinating to note how the Chinese, and other Eastern peoples, have empirically stumbled upon or have sensed fundamental nutritional principles long before they were reached, through different processes of reasoning, in the Western world. Possibly the stimulus for these empiric discoveries lies in the centuries of living close to the minimal subsistence level. Possibly the specter of starvation hanging over them, and the actuality of starvation when crops failed, or pestilence or war threatened, served as a stern incentive.

The Chinese live very close to the soil, and the great mass of the population is rural. Farms are incredibly small and are tilled with never-ceasing toil. The peasant farmer estimates his annual income in terms of land area or in terms of the quantity of rice or wheat that he raises: wheat in the dry North; rice in the hot, damp South and West. It is of more than passing interest that a traditional mode of casual greeting along a country road is "Chi lo fan mo iu?" (Have you eaten, or not?). To regularly provide full rice bowls for a hungry family is an achievement whose significance would probably go unrecognized in the America of today.

The bulk of the Chinese diet is cereal; and probably less than 10 per cent of the protein consumed is of animal origin. This, of course, is vastly different from consumption levels in America and in many parts of Europe; and the reason for this largely vegetarian diet is basically economic. Certain Buddhist practices

also exert a small influence in this picture. The Chinese are very fond of meats and have few equals in the culinary art of preparing them; but meat is relatively so much more expensive in China than in America that it belongs definitely to the luxury class of foodstuffs. The Chinese long ago realized that the food-consuming domestic animal, while it transformed food energy into work or into meat which could be used for food, made such transformation at considerable loss. Only fairly recently[1] was it shown in America that, in feeding cereal to the cow the energy to be recovered as milk constituted only 17 per cent of the original expenditure, and that when cereal was fed to the beef steer, only 10 per cent of the initial energy investment was recovered. This, to the thrifty Chinese farmer, is poor business, when he or his family can eat the cereal directly. Hence, his protein is derived principally from cereals and legumes. In this connection, it is noteworthy, in view of the contemporary American recognition of the value of the soybean, that, long centuries ago, the Chinese, familiar with many varieties of beans, came to depend particularly on that type of bean highest in protein and fat, the soybean, the one vegetable which, as Adolph points out, might, to a considerable degree, replace meat in the Chinese dietary.

Meat eaten in China is predominantly pork; for the Chinese peasant has known for many centuries that the meat yield per unit of cost is greater in pork than in any other kind; and, recently, more mathematically minded Westerners have estimated that an acre of pasturage produces 2 pounds of pork for every pound of beef or mutton.

Chinese diets are non-concentrated in comparison with those of the Occident. In consequence, a much larger bulk of food is taken. While, on the one hand, this militates against full utilization of food elements, it supplies the roughage that now receives so much emphasis in the West. With so much bulk in the intestinal contents, the Chinese do not need the widespread use of artificial evacuants found in America today.

Dairy products are, for reasons already indicated, not widely available in China. However, perhaps in unconscious compensation, children are customarily breast-fed far beyond the usual periods in the West, often to the age of 3 years or more. However, it must be pointed out, from our studies that the same custom of long-continued breast feeding is practiced in Eastern Tibet, although yak milk is readily available. It is of great interest that the Tibetans do not, as a rule, use sweet yak milk to any large extent. They prefer it soured or made into any of several varieties of cheese. In any case, long-continued breast-feeding, which, in older children, is, of course, supplementary to other food intake, has probably a definite survival value. Another interesting custom in this connection is that of giving gifts of food to the mother upon the delivery of a child. These food gifts often constitute sources for the replenishment of the mineral salt reserves of the mother, such as pickled pig's knuckles. Under similar circumstances, Tibetan women will frequently help to restore mineral balance after childbirth by eating powdered yak bone. Vegetable oils are an important part of the Chinese dietary, serving, to a degree, as substitutes for butter and cream.

It would be possible to cite many other dietary adjustments made by the Chinese during many centuries that have had great survival value nutritionally. In a discussion of foods and adjustments made by an ancient people such as the Chinese might be mentioned the methods of soil replenishment that have been practiced for centuries and have made possible the cultivation of from two to four crops per year from the soil in many geographic areas of China. As is well known, human excreta are carefully collected and laboriously distributed over the land, supplying a rich source of replenishment. Coupled with the advantages of this procedure, there are of course the great hazards of parasitic and other types of infection. Again, in adjustment to this hazard, the Chinese are accustomed to eat but few vegetables in the raw state. Now that science has demonstrated the essential nature of the vitamins and the effects of cooking upon some of these accessory food factors, we may confidently expect further dietary adjustments on the part of the very practically minded Chinese. It is not by chance alone that the national beverage is tea, with its requirement of boiling water; and that, until recently, water drunk even in the heat of summer was commonly boiled and drunk while hot.

Dietary adjustments made by the shrewd Easterners are not always of survival value. One of us (M.C.A.),[2] in her studies on the nutrition of Chinese students, refers to the "slimming" aspirations of some of the girl students, with the consumption of seriously inadequate amounts of food.

MINIMAL NUTRITION VERSUS OPTIMAL NUTRITION

We have considered examples, among an Eastern people, of dietary adjustments unconsciously, but effectively made over a very long period; adjustments which might have an instructive significance to American people who, finding themselves in the distinctly unique position of being surrounded with a bewildering amount and variety of foodstuffs, have until recently made little effort to wisely adapt their dietary habits to the requirements of exuberant health and vigor. However, it is necessary to emphasize the fact that mere minimal or maintenance nutrition is not enough. While it is suggested that the much lower consumption of protein among the Chinese as compared with Americans may mean that accepted standards of minimal protein requirement may need revision; and while the lower basal metabolic rate of the Chinese gives rise to interesting speculations, we must remember that the people of America and of the world are today living under such conditions of extreme strain and of physical and mental demand that nothing short of optimal nutrition capable of maintaining exuberant health can be countenanced by those responsible for national health.

PHYSICAL EFFECTS OF FOODS

There is by no means unanimity today regarding the effects in the mouth of the physical characteristics of foodstuffs. Many investigators believe that the persistence throughout adult life, in the great majority of cases, of anterior overbite, instead of the gradual development of an end-to-end anterior relation, is due to the effects, over long periods of time, of the soft diets of the so-called civilized era, which have eliminated to a large extent the prehensile and incisive functions of the anterior teeth. Further, it is believed that this markedly inadequate anterior function may result in faulty development of the anterior part of the mouth, with serious malocclusion and malalinement, again opening the way to periodontal damage. Watsky, Williams, Campbell and others have stressed these facts, and some have come to regard the knife and fork as primary causes of periodontal disease. A friend of ours, a leading periodontist, has inaugurated in his home a return to more primitive methods of eating, restoring prehensile and incisive function to the anterior teeth. He reports that it is not so esthetic as modern eating customs demand, but that his children will grow up with an appropriate contempt for the knife and fork.

Others deny the accuracy of the foregoing concept. The Council on Foods and Nutrition of the American Medical Association has recently issued a pamphlet on foods and food advertising one paragraph of which is headed "Mastication Not an Aid to Health of Teeth and Gums." Gottlieb believes, if we understand him aright, that mastication

per se does not affect this anterior relation, and that a return to primitive methods would not insure the development of what might be considered the ideal condition; that is, that, between the ages of 18 and 25, a slight normal overbite becomes reduced, through normal ability of the teeth to wear down apart from masticatory effects, until an end-to-end relation is secured. That this favorable development is not common today, whereas it would seem to have been more common in early times, he attributes to the fact that, in primitive times, the laws of survival in a harsh environment permitted only the constitutionally stronger to survive. Absence of wear is due, therefore, not so much to the amount and degree of functional use as to the stability of the tooth in its environment, controlled by constitutional conditions, and its resultant ability or lack of ability to undergo attrition. In the modern organization of society, the weaker members, thanks to improved hygienic and social environments, are permitted to survive. However, in these weaker members, constitutional inability to undergo attrition is widely found, resulting in the types of dentition commonly encountered—persistent overbite throughout adult life; lack of wear; jumbling of lower anterior teeth through being thrust, over long periods, against the overlying upper anterior teeth, etc.

Does successful survival in spite of a harsh or exacting environment insure normal progression to end-to-end anterior relations as above suggested? In China and Tibet, for example, we are dealing with peoples in whom the process of survival of the fittest has gone on for very long periods. Life in China, close to the subsistence level for 4,000 years, has tended to weed out the unfit. Yet there is much malocclusion and malalinement and periodontal disease, starting often in early life and following a rapid and destructive course in the cases of a large percentage of the population.

In the Chinese diet, there is little work for the anterior teeth. Food is mostly cooked and is eaten with chopsticks. Until recently, the wielding of a menacing knife and fork at the table in the presence of friends has seemed rather barbarous. Thus, foods are usually chopped or cut in the kitchen into small portions for convenient eating with chopsticks. Therefore, while there is posterior chewing, there is little anterior function. Even when, at certain seasons, raw sugarcane is chewed by old and young, almost always the incising and chewing functions are performed on the posterior teeth. Seed chewing offers an exception. The soft seeds of the pumpkin or the extremely hard seeds of melons are cracked open very skilfully by the use of the anterior teeth. However, through universal habit, these seeds are constantly cracked open at one point in the anterior dentition only, the point of greatest convenience for the individual, with, commonly, excess pressure on one upper and one lower tooth only. The angle of inclination often results in periodontal damage to the upper tooth. Where the stability of the teeth is high, as in early life, grooves resembling those seen in Hutchinson's teeth may be worn in the incisal edges of the teeth concerned.

Conflicting opinions of shrewd observers suggest the necessity of leaving in abeyance, for the present, certain decisions as to the significance of the physical character of foods and the effects of mastication. Most periodontists, however, will testify to the massage and detergent value, to the investing tissues of the teeth, of the use of tough and fibrous foods; and they will seek to insure an increasing amount of such foods in the diets of their patients.

CHEMICAL CONSIDERATIONS

It is beyond the scope of this presentation to include a detailed consideration of the various classes of foodstuffs from a biochemical point of view. Data covering our present knowledge in this field are now readily available from

many excellent sources. We shall here make only a few comments and observations with regard to some of the factors involved.

Refinement of Foods.—The injurious rôle of refined flours and sugars has received so much emphasis in recent years from laboratory and clinical investigators and observers that a steadily decreasing number of physicians and dentists condone the culinary practices prevalent for many years in which insistence has been upon the whitest of flour and the most highly refined sugar. In the East, of course, the equivalent of the white flour has been, in many countries, the highly polished rice. Now, in America, the dissemination of health information, the provision of wholewheat flour, the restoration, as far as possible, to flour of the essential elements of which it has been depleted and the effort to reduce the enormous consumption of sugar constitutes timely measures looking toward the alleviation of the effects upon the nations concerned of these widespread dietary errors.

However, in addition to their own inadequacy, the rôle of these foods in displacing other more essential elements must not be overlooked. For example, the obvious detrimental effects of the introduction of refined flours and sugars into areas such as Eskimo-inhabited territory, the habits of Southern primitive peoples, etc., should furnish and have furnished evidence of unmistakable value. However, such definite findings should not lead investigators to claim that the problem of dental caries is wholly interrelated with the simple (etiologically speaking) problem of refined foods. Studies over a period of many years among primitive peoples of Eastern Tibet[3] have brought us contact with large groups whose diet has been, apparently, relatively stable for 1,200 years. These people have never heard of refined flour and refined sugar. Their diet consists basically of whole grain barley meal with butter (in great quantities), cheese, milk and tea — the so-called "dsamba." Yet they show a caries incidence of approximately 31 per cent in population of these areas. Again, tribal groups in Western China subsisting on a quite different diet—whole cornmeal, with scanty amounts of vegetables—similarly showed a 30 to 37 per cent incidence of dental caries. These tribespeople likewise had never even heard of refined flours or refined sugars. An unforgettable experience was to pass through the town of Tsa-go-lao on a market day in midsummer (July) and to find only two commodities for sale, sacks of dried shelled corn (maize) and scanty bundles of firewood. Refinement of foods is a very important part of the dental caries picture, especially in certain environments and geographic areas; but it would seem to be a part only of the entire picture.

Minerals.—There is general agreement as to the existence of a relationship between adequacy of calcium (supply and assimilation) and dental and periodontal health. With regard to periodontal lesions, there is still considerable controversy as to the exact influence of calcium, with the result that there is not a little confusion. However, the majority of investigators agree that prolonged calcium inadequacy may result in marked absorption of bone, with destruction of the alveolar process and of the periodontal membrane. The relative adequacy of phosphorus and of vitamin D would seem to have a significant influence on the rarefaction process. In 1932, we produced in the white rat various degrees of destruction of periodontal bone and soft tissue leading to exfoliation of the tooth on low calcium diets. It is recognized, moreover, from many recent surveys of American dietaries, that calcium is one of the elements likely to be deficient. The dentist must be on the alert to check up on this vital element in the diet of his patients. The daily requirement (1 gm. in childhood; 0.75 for the average adult; 1.5 for the pregnant woman) is

readily met through the use of at least 1 pint of milk daily per adult; 1 quart during childhood, adolescence and pregnancy, and 1½ quarts during lactation. Fruits and vegetables are of course also valuable sources. The dentist should prescribe calcium through the use of natural foods whenever possible. While it may be given in inorganic form, it is considered advisable usually to avoid that type of medication. As indicated earlier, natural food sources are cheaper and may contain known and perhaps many as yet unknown factors which assist metabolism. Chronic intestinal states that might interfere with absorption and retention must be eliminated.

While the essential nature of phosphorus in the diet is well recognized, the danger of inadequacy of this element in American diets is not considered to be very great because of its wider distribution as compared to calcium. Adequacy is readily secured through the milk recommendations already given. Typical of the uncertainty in the periodontal field as to the rôle of phosphorus are the statements by some investigators that a low phosphorus level tends to cause periodontal disease, while others find a high phosphorus level responsible. Lack of uniformity in classification of the types of periodontal disease may partly explain this divergence of opinion.

The significance of magnesium in the diet is receiving increasing attention. An essential element in the diet, it is considered to be related to normal calcium metabolism. An excess of magnesium inhibits calcification. An inadequacy of magnesium causes increased calcification, in which, according to Orent, Kruse and McCollum, there is a tendency toward obliteration of the marrow cavities, and the bones, though fragile, may become solid. Forbes has demonstrated that magnesium operates against calcium largely by increasing the solubility of calcium salts. In his experiments, however, this effect may be offset by an increased phosphorus concentration of the solution. Thoma[4] has a significant phrase "the physiologic sway of magnesium over calcium." In addition to older findings on the damage to the enamel epithelium of rats in magnesium deficiency, Thoma quotes unpublished material of Becks and Furuta in which deficiency in rats caused pathologic calcification in the pulp, faulty dentin formation, resorption of periodontal bone, fibrous change in the marrow and marked basophilic staining of the bone. However, little is known yet as to the definite picture of magnesium deficiency in human beings. No special effort is necessary to secure adequacy of magnesium in the diet since foods rich in calcium are also rich in magnesium.

The fluorides are occupying a position of increasing interest and importance in dental and oral research. Their rôle in the production of mottling of enamel is universally recognized. However, there is, as yet, not so clear a picture in connection with the relationship of fluorine to dental decay. While this presentation deals more specifically with periodontal conditions, it may be of interest to point out that while a number of investigators are finding harmony between what has been accepted as pathologic degrees of fluorosis and the development of dental caries, others are not finding so clear-cut a picture. In West China and Eastern Tibet, we have found[3] that the incidence of caries among groups who have mottled enamel, or who live in areas where this condition is endemic, was equal to the incidence among those not suffering from mottled enamel or living in areas where this condition is not endemic. Moreover, a diet high in fluorine-containing food has, in these areas, not been associated with an incidence of dental caries significantly different from that in areas where the diet does not contain fluorine in appreciable amounts. In view of divergent findings, to date, it would seem that definite conclusions regarding the oral effects of fluorosis, other than the production of mottling of enamel, must be held in abeyance, pending more conclusive evidence.

Other inorganic elements of foods, such as iron, iodine, sodium and sulfur, are known to be essential to the body economy, but special dental and periodontal interrelationships, if any, are as yet little understood.

Some investigators have placed considerable emphasis upon disturbance of the acid-base equilibrium of the body in relation to the etiology of periodontal disease. Broderick, for example, contends that, frequently in the background of periodontosis, there is a disturbance of acid-base balance resulting in abnormal alkalinity of the tissue fluids. Nutrition is believed to be frequently a factor in acid-base disbalance. Further clarification is needed in this field.

Fatty Acids and Salivary Amylase.—Box has advanced a theory that fatty acid material from various sources, and varying in amount, is made available in different ways as a protective coating for tooth surfaces. These sources include degenerating cells, such as leukocytes, and epithelium; saliva itself (possibly phospholipids); diets that are high in animal and vegetable fats, and cereal starches. He recalls that Ruhland and Wolf have recently shown that, in the seeds of cereals, the amylopectin fraction of starch is esterified with the fatty acids—palmitic, oleic and linoleic. He considers that salivary amylase releases fatty acids from cereal starch and that these may perform a protective rôle in the mouth.

> Where the activity of salivary amylase is impaired for any reason, the amount of the protective higher fatty acids from cereal starches is decreased. In such cases, cereal starches constitute a liability from the caries standpoint. With adequate activity of salivary amylase these starches may constitute an asset, and play a part in the mechanism of caries immunity.

From the periodontal standpoint, Box believes that

> Under suitable conditions, fatty acid apparently acts as an intermediary in the formation of calculus. The presence of fatty acid on the border of advancing calculus has repeatedly been shown by laboratory tests.

The Vitamins.—The vitamins occupy so large a place in medical and dental literature today that it is unnecessary here to define their status in detail. Profound effects of vitamin-A deficiency upon the growing tooth have been recognized for some time, the atrophy and keratinization of epithelial structures, faulty enamel formation, etc. It is believed by some that atrophic changes may affect also the mucous membrane and the salivary glands. Hyperplasia of subgingival epithelium is claimed to be of similar etiology, with lowered resistance to bacterial invasion. One investigator states that one fourth of the total incidence of gingivitis and of periodontosis is related to a deficiency of vitamin A.

Marked development of our knowledge concerning the vitamin-B group has come in recent years. While the B family is now a large one, present findings would suggest that only three members of the family, B_1, or thiamine; B_2, or riboflavin, and nicotinic acid, or the pellagra-preventive factor, have been as yet clearly related to human metabolism. It is probable that B_6 will be placed in that category also. The relation of thiamine deficiency to the development of beriberi is well-known. Some consider, in addition, that its adequacy affects appetite and general vitality. Clinical symptoms attributed to deficiency of vitamin B_2, or riboflavin, and readily amenable to vitamin therapy are angular cheilosis (transverse fissuring at the angles of the mouth), seborrheic accumulations at the alae of the nose, dermatitis, redness of the conjunctiva, etc. Nicotinic acid deficency is associated with pellagra symptoms: glossitis; stomatitis; swelling and ulceration of the tongue; the presence of a white exudate on the buccal mucous membrane, palate, pharynx, etc., char-

acteristic dermatitis of the hands, elbows, knees; mental conditions, etc.

It is claimed by some that Vincent's infection, which is often associated with the foregoing conditions, is relieved by administration of nicotinic acid alone. However, others have failed to secure such clearcut results. Some have had success in using a general B-complex treatment. On the whole, therefore, it is seen that the vitamin-B group is of definite significance to the dentist. Further, the problem of adequacy in American diets is great, since so much of the caloric requirements is obtained from refined flours and sugars.

Reference might here be made to the condition known as *cancrum oris,* or noma, inasmuch as its etiology links it with Vincent's infection. This extremely grave disease has become a "textbook disease" in America for the reason that it has rarely been observed on that continent in recent years. As a strictly preventable disease, its disappearance is readily understood. It is, however, still prevalent in many parts of the world. Recently, Topping and Fraser, experimenting with avitaminoses in relation to mouth disorders in monkeys, found that while *cancrum oris* could be produced, it developed in the buccal mucosa only in monkey receiving diets deficient in vitamin B_2. Monkeys maintained on a stock diet gave no evidence of gingivitis or stomatitis when material from affected monkeys was transferred directly to them.

In West China, we have had considerable experience with *cancrum oris.* In all of the cases treated or observed, there has been an invariable situation—a badly undernourished child, with a dirty mouth, suffering from or recovering from an exanthematous disease such as smallpox, scarlet fever or measles. Under such conditions, *cancrum oris* may develop. It is also known to follow typhoid fever, blood dyscrasias, kala-azar, etc. In the cases treated, there has appeared always to be multideficiences; and, of course, in view of the deadly rapidity of development of the lesion (in untreated cases, or cases that are not seen within three or four days after onset, death usually occurs in from eight to ten days, accompanied by horrible mutilation), it is necessary to give drastic treatment, surgical and bactericidal, with immediate and thorough nutritional fortification. Experimentation with individual nutritional elements would, in such cases, scarcely fall within ethical limits. However, it is hoped that further studies will throw more definite light on this problem.

Vitamin C has come under the spotlight in America and Europe, and much publicity has been given to the effects of C deficiency: inability of the tissues to form normal intercellular substance; damage to matrix of bone; interference with dentin formation; injury to vascular endothelium, etc. While, at the present time, a frank scurvy is seldom encountered, the dental profession is becoming keenly alert to detect borderline conditions, and it is felt that such mild deficiencies are more numerous than is commonly realized. Periodontal conditions attributed to C avitaminosis include congestion of the gingivae, ready hemorrhage, rarefaction of alveolar bone and widening of the periodontal membrane. Boyle, Bessey and Wolbach[5] report the experimental production of lesions comparable to those seen in man in diffuse alveolar atrophy of parodontosis (complex periodontitis, systemic), including loosening and wandering of teeth, alveolar resorption and pocket formation. Some investigators assert that a low serum value for vitamin C does not necessarily indicate hypovitaminosis; and that other disease factors must be present if lesions are to be initiated, even in the presence of low C values.

Studies in Eastern Tibet indicated to us and our associates the probability of the existence of a widespread chronic vitamin-C deficiency. Dietary studies showed lack of adequate sources of the vitamin. Gingival conditions corroborated a low-C picture. Study of urinary excretion of ascorbic acid showed low levels, harmonizing with clinical and dietary findings. In the course of the investigation, Tibetan lamas from two distant areas not included in the study described a disease (Tibetan "um-bang") that fitted the picture of acute scurvy. Questioning as to this disease in these areas included a query as to any empiric measures taken by the patients themselves to alleviate the condition. It was interesting to find that such patients would seek a vegetable, identified as a type of turnip and hard to obtain. The turnip is sliced raw and the juice is strained through a cloth, and this juice is used in treatment of the condition. Thus, while Western science has, in recent years, established the efficacy of the turnip as a source of vitamin C, the Eastern Tibetans have been using it for a similar purpose for perhaps many centuries.

The functions and indispensability of vitamin D have received much attention in recent years. Its lack of availability in adequate amounts in ordinary foods, its elaboration through the effects of sunshine on the ergosterol of the skin and the inability of clothing and of ordinary windowglass to transmit ultraviolet rays, its ability to further normal calcification through maintaining normal concentrations of calcium and phosphorus in the blood, the formation of uncalcified osteoid in its deficiency and interference with endochondral growth of bone are well known. Widely known also are its effects upon the teeth, its deficiency causing hypoplasia of enamel and of dentin and constituting a factor in the dental caries picture[6, 7]; its deficiency affecting the jaws adversely, causing irregularity of the arches and malocclusion, although causing these usually only when another factor, such as mouthbreathing or thumbsucking, is present; its deficiency causing, in the experimental animal, osteoporosis and marked osteoid production (we have [1932] produced marked osteoid growth in rats with "osteoid ankylosis"); its particular importance during pregnancy; its influence on the gingivae and the development of a characteristic gingivitis with local or generalized bright red coloration of the margin; its association (Mellanby) with deep pocket formation and alveolar bone damage in dogs, etc.

Finally, the dentist must not become so engrossed in the search for a possible single vitamin deficiency that he overlooks the possibility of a polyvitaminosis, with a result, produced collectively, that might not be possible in the case of a single deficiency.

The Endocrines.—No attempt is made, in this presentation, to deal with the problem of endocrine dysfunction and disturbances of dental and periodontal health, inasmuch as this constitutes a separate study. It would seem that many fields, of the highest significance to the periodontist, are gradually opening through an increasing knowledge of the nature and functions of the endocrines and of the effects of disturbances of equilibrium among their component parts. The possibility of adverse nutritional influences on endocrine function must not be overlooked in the study of these conditions.

Pressing Problems of the Future.—Problems of peculiar interest and importance to the dentist and periodontist, in connection with which much has already been discovered and much still remains obscure, would seem to include (a) nutritional aspects in the etiology of diffuse alveolar atrophy (complex periodontitis—systemic); (b) the accurate detection and diagnosis of borderline deficiencies; (c) effects of the quality of the soil (mineral and vitamin content) on the mineral and vitamin content of

foods; (d) effects of the stage of maturity of fruits and vegetables on their nutritional value; (e) food allergies and gingival and oral relationships; (f) practical methods for improvement of national food habits looking to moderation of sugar consumption; (g) use of unrefined and non-concentrated foods; (h) application of intelligence in the choice and balance of foodstuffs, and (i) provision of foods of appropriate physical characteristics to insure adequate functional stimuli of the dental organs.

The future of the profession of dentistry as a vital health service lies in the enlightened expansion of its biologic bases.

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53 Turner Road, Toronto, Canada.