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1 A PRELIMINARY STUDY OF THE DIET AND CUSTOMS
OF THE KOREAN PEOPLE, WITH RELATION
TO THEIR ORAL CONDITIONS

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CHAPTER I. DIET AND CUSTOMS

In the Korean peninsula there are twenty three million people, and because of having been secluded from the outside world for thousands of years, the life habit of the inhabitants presents, in a large measure, certain interesting relationships between diet and diseased conditions. (Census of 1935 indicate 22.89 millions). Very little scientific investigation has been made, and practically none from a dental approach. As far as I know no work on Korean dental conditions has been published in the foreign language.

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PART 1. THE PEOPLE

The Koreans came originally from the plains of northern China and are Oriental in their general characteristics; in ~~stature~~ they are a little taller than the Japanese and smaller than the northern Chinese. They may be described by the sentence which Pickerill uses in speaking of the Moors of Morocco—"A people of a very ancient civilization but with a mode of life considerably simpler than ours." Eighty per cent of the population gain their livelihood by agriculture, most of them being engaged in the cultivation of rice.

PART 2. CUSTOMS

The living habits, food and health of any people are inseparably connected with their economic conditions. The Koreans are generally poor. Wages for unskilled labor average about one yen a day in the city and slightly less in the country. Farmers live in villages near their fields, an isolated house being rarely found. They eat and use, in the main, products of their own labor and little actual money changes hands. The cow is the common beast of burden, but is not used as a dairy animal. Both animal and human excreta are used for fertilization throughout the entire country.

In the cities modern material civilization affects the native life. More people work steadily throughout the year, more money is used in exchange, and a much greater variety of foods is obtainable, many items of which are usually added to the native diet or in a few cases possibly replace it.

PART 3. DIET

The diet of the Korean people is interesting for study on account of its comparative simplicity and lack of divergency in certain respects; it has been standardized with practically no change for many generations. However, distance and isolation and uncomfortable living conditions in the country districts have not been conducive to investigation by foreigners.

A. ARTICLES AND THE PREPARATION OF FOOD

Rice: Rice forms the bulk of the diet, the amount per person averaging one and one-half pounds of dry rice daily. One's social position is often determined by whether he eats polished rice, hulled rice, rice mixed with other grains and beans, or potatoes, the scale falling in the order named. This custom is so well established that all lowland which can be dyked and drained is thoroughly cultivated, while the higher fields which would grow fruits, grains, vegetables and pasturage are of little value and receive poor attention.

The winters are cold throughout the peninsula. The climate is good and the soil fertile, yet the main crop depends upon the amount and the time of rainfall during the summer season.

The rice, with enough water to cover it, is boiled in an iron vessel over a wood fire, until a layer of browned rice covers the surface of the pot. It is then allowed to steam slowly until eaten. It is "thicker" and the grains drier and more glutinous than is usual in America. The weight of the cooked rice is about three times the weight of dry rice. No seasoning is used.

Kimchi: With the rice, a small bowl of *kimchi* is eaten. This pickle is somewhat like American sauerkraut. Usually, cabbage is the base and to this are added turnips, red peppers, garlic and shredded fish; *all the ingredients are uncooked*. Quantities of the mixture as big as one's fist are rolled in cabbage leaves, packed in a crock, covered with salt brine and allowed to "ripen".

In the city home, in the country home, in an inn or restaurant, I have found these two dishes, rice and *kimchi*, followed by a drink of the warm rice water, to represent the main portion of the meal for the average breakfast, dinner, and supper.

Exceptions: There are exceptions to this rule. The rice item is varied by adding beans or peas or mixing with millet; in the poorer homes it is often replaced by millet or barley, and in the high mountain districts, by potatoes. Beans are under-cooked and quite indigestible.

Different varieties of *kimchi* kraut are sometimes prepared for temporary use in the spring and summer, after the regular supply which must be kept cold, cannot be eaten. Cabbage, turnips, and red peppers are still the main ingredients, but bean ~~sauce~~ is often added. Salted turnips alone are also so used.

Soy beans are boiled, mashed, and made into cakes. These are dried and stored some months and allowed to mold and ferment. When ripe they are broken and soaked in salt water, then strained. The liquid is boiled to the right concentration and used as a condiment in many foods in every Korean home.

Bean and pea curd, precipitated soft proteins, are used with soup and eggs or served with bean sauce and an oil prepared from sesame seed.

Sprouted beans are common, both beans and sprouts being boiled and served with sauce.

Spinach and all edible greens and plants called San-tchai that are grown in mountainous regions are eaten, and it is the experience of generations that in times of severe famine people of the affected district make use of certain common grasses as food.

Steamed bread is made from hulled glutinous rice. It is soaked, boiled, then kneaded on a flat stone or wooden block and beaten with a heavy mallet. It is quite tough and indigestible.

Vermicelli is made from buckwheat flour and is always found at the city guest table in soups. In the country, it may be found as a special dish during the winter months.

Eggs are common, inexpensive and cooked in a variety of ways, with and without other foods. The chickens, however, are poorly fed and in many districts in the interior, there are no eggs over certain periods of time.

Meat: Chicken, beef, and pork are eaten regularly by the more wealthy; common people may have a small piece of any of these meats, used in soups and stews, or boiled, several times a week. Gamepheasant, wild duck, deer and wild boar are obtainable during the winter. There is no mutton and the sale of veal is prohibited. Although dogs are not marketed for food, I am told they are not infrequently eaten in the country districts, such practices resulting from superstitious ideas of preventing summer epidemics.

All the viscera would be closely associated with the philosophy and science of the Oriental medicine that the Gall of bear is believed as antispasmodic and sedative and sometimes antipyretic to infantile fever of certain types, and that the blood of certain animals, especially the deer and boar, strengthen the weak and invigorate the health of the old.

Vitamin investigators (44-P. 149-159, 66, 21) have pointed out the relative value of eating viscera compared with our custom of eating only the muscle cuts which are "storage" and not "biologically active" foods.

Sea Food: Fish, clams, and shrimps are eaten, cooked or dry-raw, especially by those near the seashore. Fish are commonly sundried for preservation. (There are very few fresh water fish.)

Sea weeds, very salty to taste and high in mineral content, are plentiful and not only eaten along the seashore, but are sometimes carried into the mountainous districts and enjoyed by all people, usually being cooked in bean or sesame oil.

For many years, nuts have been an article of diet among Koreans, especially chestnuts, raw, roasted and crushed in soups, also pine-cone nuts and peanuts.

Fruits: Oranges, the small, loose skin variety, apples, a large luscious sweet persimmon and a hard watery pear are the most common fruits and are eaten in the usual manner and served as dessert in the better class meals.

Liquids: An alcoholic drink, made from rice and containing about

15% alcohol is used by probably half the male adults throughout the country. The universal beverage, however, is the thin warm "pot liquor" made in the rice pots and drunk during and after meals.

Tea, coffee, cocoa and carbonated drinks are not used. Unsweetened tea is so very common in the dietaries and so important in the social life of the neighboring countries, that it is of interest to note that the Koreans have not established a habit of drinking it except among the Buddhist priests who live in temples in the mountains and among people of this particular religious sect living in cities.

The Koreans are a very hospitable people and all of these foods besides the regular rice and kimchi would be used in entertaining and feasting. A greater variety is also found in normal, daily life among the wealthier people and the city people.

B. DIET VARIATIONS

Seasonal Control changes the vitamin and caloric content of the diet in most districts. Ice, canning and the American methods of food preservations are used in the cities, so that many things are available only in season.

Geographical control seriously affects and differentiates the diet of a village along the sea coast from that of one far in the mountains on account of the lack of railroads, automobiles, highways and general transportation facilities in the latter district, the people along the coast and railway using much fish and seaweed in the daily diet and those in the mountains using little fish, less rice, and more dry field grains, tubers and "greens".

C. COMMON ARTICLES OF FOOD NOT FOUND

In these days when so much stress is placed upon the importance, if not the absolute necessity, of milk in the diet, it is interesting to note that though the cow is the most common animal, there is no dairying among the Korean people. McCollum (44-P. 152) states that milk is one of the foods for which there is no effective substitute, yet there is no milk nor butter used in any district, by any group.

Sugar is not native to the diet but is being adopted in the cities and wherever Japanese or "western" influence affects the food markets. The local manufacture of beet sugar was begun in 1919. The only sugar in the natural diet is in the form of wild honey and candy made by rice or red millet, which is not used daily but is frequently found in the better class of homes as dessert. This is dextrose, a monosaccharide. From the rice they get vegetable starch, a polysaccharide. The disaccharides, cane sugar and lactose or milk sugar, do not appear in the regular

native diet, although the disaccharide maltose is the chief sugar formed from starch by the diastatic ferments contained in the saliva (ptyalin).

D. CALORIC VALUE

Van Buskirk (66) has found the caloric value of typical diets in Korea adequate for the size and activity of those whose diets were studied. The average caloric value of the diets for men was 2768 calories and for women, 2380; for warm laborers, 3213 calories, for office workers 2180. Several diets were clearly deficient, as low as 876 calories a day. The average protein caloric value was only 86 and the lipins 18. Of sixty men having a total caloric average of 2768, the average obtained from rice and rice mixtures was 1776 and from kimchi 370. Most of Van Buskirk's experiments were done on people having, I believe, a larger variety in the diet than the typical peasant.

E. DIET DEFICIENCY DISEASES

In spite of an apparently unbalanced and limited diet, no appreciable occurrence of any of the deficiency diseases has been reported.

With the absence of dairy products, we might expect xerophthalmia, but though the trachoma is not as common as in Japan proper, no typical deficiency xerophthalmia has been reported in our larger clinic.

There are no endemic areas of beri-beri as in Japan although the disease has been frequently reported. The crude method of hulling grain, grinding between two stones, suggests that there remains enough of the protective elements so that, together with a daily consumption of uncooked vegetables, a general resistance to beri-beri is maintained.

The consumption of greens and fruits in the summer and of uncooked vegetables in the winter will account for the apparent absence of scurvy.

Small and uncomfortable homes send the children out of doors for most of the time. Bright sunshine and white clothes, if any, explain the absence of rickets. To a casual observer, the bowed legs of the children, caused by strapping the child on the back of the mother or sister, with the legs around the abdomen, the pigeon breast, caused by the tight binding of the child's clothes around the waist, the flat head and scraggly hair, caused by the practice of placing the babies flat on their backs on a stone floor, give the impression that rickets is common, but actually the disease is rarely seen.

F. VITAMIN CONTENT

Unfortunately, we do not know the vitamin value of "kimchi". Van Buskirk has done a preliminary work in approximating the total

vitamin content of Korean diets with regard to A, B, and C and reports an apparent general deficiency in vitamin A, being marked in some cases. Of the 83 food lists examined, he estimated the vitamin A content as fair in only 21; in 36 of the lists it was of doubtful sufficiency and in 26, definitely deficient.

Below is a chart of the most common Korean foods with their vitamin content. (A, B, C—Sherman) (D & E—McCollum personal conference)

	A	B	C	D	E
Barley	+	++	—		+ ?
Millet	++	+	?		+ ?
Rice Polished	—	—	—		—
Rice Whole grain	+	+	—		+ ?
Haddock-Fish lean	—	+	?	+	
Herring-Fat	—	++	?	+	?
Heart	++		?		+
Liver	++	+	?		++
Muscle meat	+	+ ?	+ ?		+
Orange juice	+	++	+++		+ ?
Beans soy	+	+++	—		?
Beans sprouted	?	?	++		?
Cabbage raw	++	+++	+++		++
Lettuce	++	++	+++		+++
Peas	+	++	+ ?		?
Onions	?	++	++		?
Spinach	+ ++	+++	?		++
Chestnuts	?	+	?		?
Peanuts	+	++	?		?
Eggs	++	+	+ ?	+	++
Dandelion greens (fresh)	++	++	+++	?	++

+ Denotes Plus

(This differs somewhat from Harrows list as quoted in "Teeth Diet and Health" by Thoma.)

Zilva and Drummond (44-P. 318) found that vitamin A is characteristic of fish oils in general. In Korea a large proportion of the fish are eaten whole, after being sun dried. The vitamin A is probably not only retained but energized by radiation.

Hjort (44-P. 312) found vitamin A in sea weeds, diatom plankton and the roe of herring and cod.

McCollum (44-P. 314) writes "it has been known for several years that the leaves are rich in vitamin A" and Wilson (44-P. 314) found that either itiolated or green wheat sprouts furnished sufficient vitamin A for the growth of white rats.

McCollum and Davis (44-P. 303) also found boiled egg yokes to be a source of vitamin A and that (44-P. 158) the fats of eggs were fully comparable with butter fat.

McCollum, Davis, Howe, Masaki (66) and others have shown such consistent results in producing xerophthalmia and morphological changes in dental tissues in laboratory animals by the feeding of diets deficient in vitamin A, that, considering the Korean's consumption of large amounts of yellow grain (millet), sprouted grains, uncooked leafy vegetables, seaweed, whole fish, eggs and viscera, all containing vitamin A, together with the reported absence of xerophthalmia and the universal presence of well formed, sound, sclerotic teeth of small imbrication and high resistance, it would seem that there is a greater amount of vitamin A in the Korean diet than has heretofore been thought.

Though there may be a marked deficiency during some seasons, McCollum (P. 329) points out that it may require several months to induce deficiency diseases in man through the agency of a defective diet. It is probable that before faulty metabolism could change tissue form, vitamin foods would be again in season and added to the diet.

The assumed sufficiency of vitamins C and D and sun rays and corresponding rarity of scurvy and rickets suggest a direct relationship to dental conditions. Numerous writers have pointed out the close relationship of rickets and scurvy to faulty tooth development and lack of resistance to caries.

G. CALCIUM METABOLISM

Probably no subject in Korean dentistry offers such interesting opportunities for study as the relationships between diet, calcium metabolism and teeth. Unfortunately we are not prepared to write of it now and must look forward to comparing the findings of Price, Mellanby, McCollum, Howe, Davis and others, in our future study in Korea.

Rumsey (54) says the calcium supply in our diet is from milk, manufactured milk foods, cheese, animal jellies and hard water. The Koreans have none of these but the last and its availability is doubtful. They must have some good source of calcium and, at least during the time of the formation of the teeth, a normal calcium metabolism, or such perfectly formed and strongly resistant teeth could not be produced.

McCollum repeatedly points out the value of leafy vegetables as "protective foods" and their ability to supply vitamin A and calcium. McCollum (44-P. 141) states "the leaf is rich in just those elements in which the seed is poorest, calcium, phosphorus, sodium and chlorin." "There is a marked tendency," he says, (44-P. 541) "for the average American diet of today to be deficient in calcium," while that of the Korean has a fairly good supply of seaweed, leaves, and leafy vegetables.

Sherman and Davis (44-P. 361) found that children should have 1

gm. as an optimum daily intake of calcium and that children did not seem to utilize the calcium of vegetables as efficiently as they did that of milk.

Almost all the babies in Korea are breast fed. The mother for several weeks after the baby is born, refrains from eating kimchi and adds to her rice diet, meat and seaweed, the latter, rich in iodine and mineral salts. This should favorably influence the formation of the teeth of the nursing child.

H. THE SALIVARY FACTOR AND THE USE OF SALT

If caries can attack the teeth only in an acid medium, we are concerned with the acidity or alkalinity of the saliva. The matter of the use of salt in these habits of the people is of great interest to us.

Although they use no seasoning in the rice, the seaweed and *kimchi* which are eaten with the rice, are very salty. Furthermore, it is almost a universal custom to wash the teeth and gum tissue, after eating, with coarse salt held on the ball of the middle finger. This is done not with the idea of preventing decay nor of stimulating digestion, but to give the satisfaction of a clean taste and breath. I have frequently found Koreans who have tried the toothbrush but returned to the salt and finger technique, insisting upon its greater efficacy as a mouth cleanser.

Stillman and McCall (56) recommend the use of salt as a dentifrice, claiming the efficiency of the saline solution to be in its activity as a solvent of mucinous precipitates and in the promotion of osmosis in the vascular structures. Rumsey (54) discussing the salivary digestion of carbohydrates, thinks the enzyme ptyalin is inactive in the absence of electrolytes, as its influence is dependent upon the negative ion. He claims the optimum concentration of sodium chloride is between .02% and 2%, and that the difference in the action of the enzyme in salt free mixture and in one containing even .02%, is enormous. He suggests that salt used in cleaning teeth after meals will first, reflexively stimulate a flow of saliva to help in digestion; second, have an astringent action on the gums and mucous membrane; third, probably produce an antiseptic action on the gums and mucous membrane; fourth, inhibit the precipitation of calculus.

Pickerill has written extensively on this subject in his chapters on "The Forces of Natural Protection," and I wish to make several references to his work. The Korean eats *kimchi* containing red peppers, usually two or three times a day. The sensation is of burning or pain. Pickerill states that (49-P. 203) "the effect upon the salivary glands of painful sensation is known to be stimulating."

His work agrees with the other writers on the influence of sodium chloride as a marked stimulator of both volume and alkalinity of saliva.

Explaining the chemical action in salivary neutralization of lactic acid, he says (49-P. 161) "as each molecule of lactic acid is formed, it searches for something wherewith to combine. Alkaline salts of the saliva will obviously most readily satisfy it, but should these not be available, then the calcium phosphate and carbonates of the enamel will be attacked." It is important, then, to note that the normal Korean mouth is daily provided with sodium chloride, providing plenty of alkali to neutralize any acid present and leave the enamel free from attack. Quantitative analysis must be made, however, before this could be accepted as a definite factor in the resistance or susceptibility to caries.

Considering then, the different foods that might counteract the influence of salt, of foods mentioned as depressants of salivary alkalinity, (49-P. 147) chocolate, cake, grapes, bananas, figs and dates,—there are few in the Korean dietary except a few grapes and figs. Of those that depress the salivary secretion, (49-P. 160) bread and butter, tea, tannic acid, sodium carbonate and meat,—few are in the Korean dietary except a very little meat.

(49-P. 227) Of the foods that gave rise to the most prolonged acid reaction in the mouth—pastry, toast, chocolate, biscuit, bread crust, and cane sugar,—few are used in Korea and all are most common in America.

(49-P. 227) Of the foods Pickerill listed as having a relatively high potential for initiating caries, all are originally alkaline and few appear in the Korean diet lists.

Pickerill then considered combinations and sequence of salivary acids and depressants and found that "in a mouth in which the teeth are fairly regular and in which there are no gross cavities to retain the previously eaten soft fermentable food, then we may with safety say that, if such food be followed by articles of alkaline potential and salivary excitants, the tendency to caries will be enormously reduced or entirely negated." I have stated above and also under "fruit" that the Korean customarily follows his carbohydrates food with fruit, salt, or salt mixtures, all alkaline potentials and salivary stimulants.

When we begin to apply these findings as factors in the etiology of caries, many other factors will enter and complicate the matter. It is interesting to note that Stefanson (58) reports the Eskimo as not liking the taste of either salt or sugar, and the Eskimo has less caries than the Korean.

PART•4. GENERAL DISEASES

Tuberculosis, venereal diseases, malaria, dysentery, small-pox, the fevers, and a variety of benign and malignant tumors are common in all

parts of the country. There is a fair amount of leprosy and sprue. Noma frequently follows scarlet fever or measles among the children. Diabetes and both types of goitre are seen, but not nearly so much as in America.

CHAPTER II. INVESTIGATION OF ORAL CONDITIONS

PART I. MATERIALS AND METHODS

I am presenting the data on 1380 cases, examined for the purpose of this survey, bringing out items of interest to dental investigators. The cases are divided into seven groups of different sizes, according to their living conditions and locations. All items were not noted with consistent care in all groups, but sufficiently to get correlations of the most important.

The findings are not perfect. It is very difficult to get an exactly true answer when the questioner is handicapped in using a language not of his own and the person examined has no knowledge of why such apparently foolish questions are being asked. All examinations were made by observation with a mouth mirror and explorer and in no case were X-rays made; thus the percentage of impacted wisdom teeth would show lower than the actual.

With reference to malocclusion, there seems to be some disagreement in our dental literature as to just when we have malocclusion. For instance, Leigh (37-P. 887) found in Eskimo skulls an edge to edge anterior bite very common and considered it normal. I have no record of the percentages of such cases in Korea but would have marked them positive for malocclusion. Where the teeth were irregular or where, without models, it was apparent to the eye that one or more teeth were not in normal centric occlusion with their opponents, with the mouth closed, all such cases were termed malocclusion.

Another writer says we cannot diagnose pyorrhea without a bacteriological examination of the mouth. We made none, of course. If the inflammation of the gingiva seemed to be of a degree to suggest closer examination and the teeth were found to be loose, or pus was seen when the membrane overlying the teeth was pressed by the fingers, we marked it as positive for pyorrhea.

To anyone familiar with the detailed classification of periodontoclasia, as taught by Stillman and McCall, our divisions of gingivitis and pyorrhea will seem quite crude. As they point out, a classification such as we made, is based upon coincidental but not necessarily fundamental phenomena. A very common type having deposits, some recession, no pockets and occasional pus, we have classified as gingivitis, or pyorrhea, depending upon the apparent absence or presence of pus. Stillman and McCall use

neither of these terms, but call the condition "calcic ulatrophia." Also, they point out, "pocket formation may take place without the premonitory signs of gingivitis, such as redness, intruding themselves upon the consciousness of the observer."

Nevertheless, the correction of the probable errors would increase the percentage, and our results, without details, give some idea of the amount and degree of periclasia.

In each group we tried to get a cross section of the people in the community, but it is probable that some of those not conscious of dental disease would not submit to examination.

Admitting these faults in the method of examination to be too great to use the findings in conclusive proof of any theory, they may provide a foundation for future study, and are accurate enough to be of value to many of us who are interested in dental pathology.

PART 2. DESCRIPTION OF GROUPS

Group No. 1 consisted of 173 boys in a high school in the city. Some of the boys lived in a dormitory and some not. Most of them were in the city for the purpose of attending school, their homes being in the country districts so that their diet, undoubtedly, was quite different from what it had been one, two, three or four years before, depending upon their number of years in the city.

The boys were from sixteen to twenty-three years of age, and no differentiation was made in over and under twenty-one as in the other groups. They were under the usual city conditions and eating a city diet. They were high in intelligence, experience, and personal hygiene, compared with the country groups.

Group No. 2 consisted of 461 girls in a high school in the city. Nearly all the girls lived in the school dormitory and usually ate the same diet. Like those of Group No. 1 many spent their childhood in the country villages or smaller cities and came into the city to attend this school. The members of this group were also high in intelligence and personal hygiene.

Group No. 3 consisted of 345 patients in our dental clinic. They were examined for this survey, without regard to age or present complaint, and with a view to getting a fair cross-section of clinic conditions.

Group No. 4 consisted of 165 inhabitants of a village along the shore of a small island off the west coast. Korean and Japanese boats traded here. Sea food, plant and animal, figured largely in the diet.

Group No. 5 consisted of 137 inhabitants of a mountain village in the northwest, differing from the average village in that it was built

around a large Buddhist Temple. The effect of this influence would normally be the absence of meat and fish, for the Buddhists do not believe in the killing of animals. The food was larger in variety and better in grade and contained a higher proportion of rice than that of an ordinary mountain district, on account of the comparatively good roads which lead to such a religious mecca.

Vegetables and rice with kimchi in the winter and greens from the hills in the growing season formed the main diet. Refined Japanese sugar was eaten two or three times a week, usually cooked in the food. Wild honey was fairly common. Meat and fish were almost totally absent. These people used a "tooth brush" made of a piece of wood flattened at one end and pointed at the other, the flattened end being used as a scraper, and becoming frayed, like a brush. Three kinds were to be had, from the willow to whiten the teeth, from the peach to strengthen the teeth, and from the pine to sterilize the teeth.

Group No. 6 was the most primitive of all and differed in several ways from all others. These 89 people lived in a mountain village with very little trade and little money changing hands. Outside of occasional wild honey, they ate no sugar. They got meat only when they could kill wild boars in the deep snows of January and February. A little fish was used, perhaps once a month.

The diet most resembled that of the other groups in that they are large quantities of wild greens from May until October. It greatly differed from the others in that they got rice only about ten times a year, the bulk of the diet being millet and potatoes. No tooth brush of any kind was used, but the mouth was customarily "cleansed" by rinsing after each meal.

Group No. 7 was very small, consisting of ten boys in an island village. Looking out the door of the thatch roofed hut which formed our camp, in a small village in the high mountains, I noticed that there were ten boys of the deciduous teeth age who had come, not to be examined, but to see these strange foreigners with deep set eyes, long noses, and light hair. I got the mirror out of my kit, and bribing each with a small coin, as they examined me, I examined them.

CHAPTER III. STATISTICAL RESULTS

PART 1. TOTAL PERCENTAGES

Table No. 1 shows the total percentages in each group for each item recorded, and for the most important items, the total percentages for all groups combined.

A. TABLE NO. 1

Item	Groups No. of cases	Total Results, by Groups, in Percentages.							Total
		No. 1 173	No. 2 461	No. 3 345	No. 4 165	No. 5 137	No. 6 89	No. 7 10	
No. 1 Age-under 21		-	-	23	58	67	45	100	
No. 2 Sex-Male		All	None	52	62	61	60	100	
No. 3 Caries		32	51	76	53	42	45	10	53
No. 4 Sugar		47	91	25	40	27	0	0	50
No. 5 Anterior Decay		3	2	1	4	1½	9	0	25
No. 6 Deciduous Decay		1½	-	1	-	-	-	10	
No. 7 Stain		2	43	-	13	39	93	10	34
No. 8 Tooth brush Used		61	13	38	18	94	0	0	26
No. 9 Deposits		100	97	-	92	86	74	40	93
No. 10 Gingivitis		97	94	-	76	62	98	30	
No. 11 Pyorrhea		4	3	48	38	33	60	0	
No. 12 Abrasion		8	9	-	-	-	-	-	
No. 13 Malocclusion		24	88	-	89	96	85	50	
No. 14 Irregular Alignment		30	19	-	-	-	-	60	
No. 15 Protruding Anteriors		27	34	-	-	64	24		
No. 16 Mouth Breathers		-	-	-	26	-	-		
No. 17 Impacted Third Molar		3	2	17	2	0	1		
No. 18 Former Dental Service		5	12	44	27	14	8	0	20
No. 19 Residence in City		5	47	86	0	0	0	0	

Chart No. 1

CARIES

Comparative percentages of the number of cases having caries, in each group

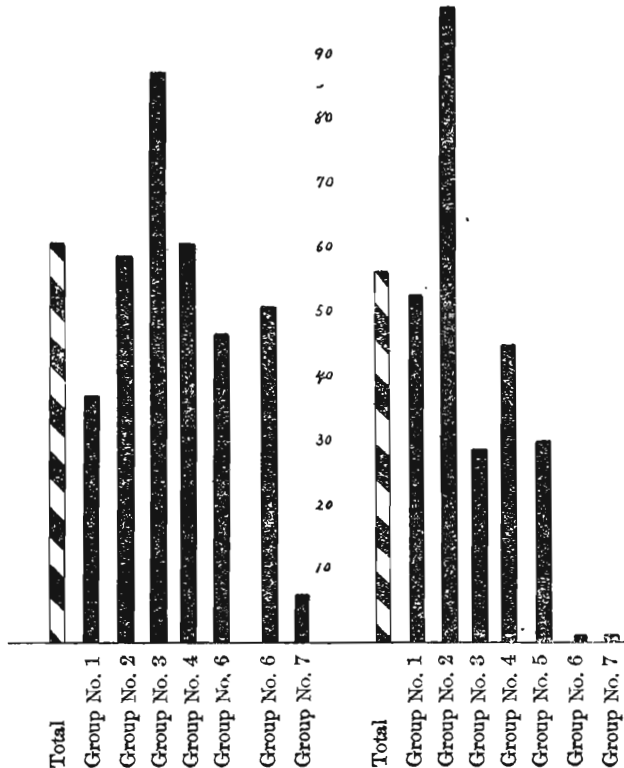
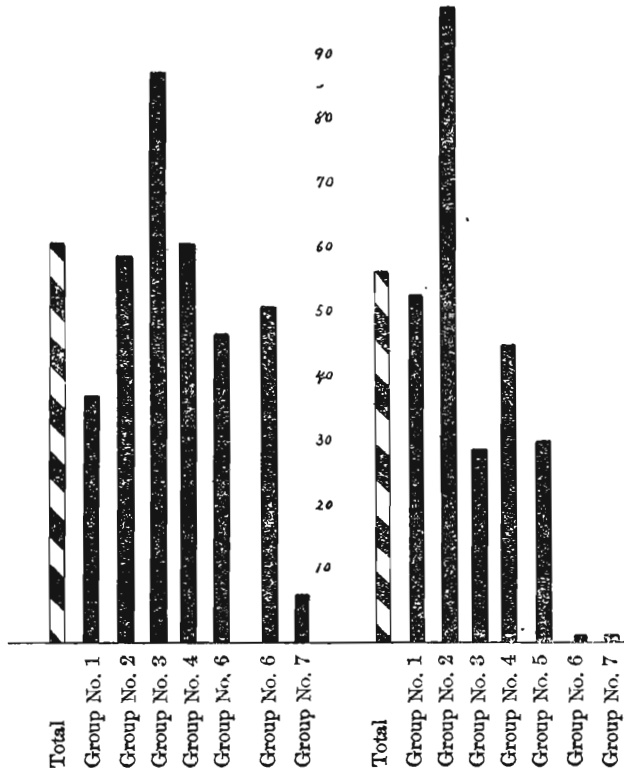


Chart No. 2

SUGAR

Comparative percentages of the number of cases using sugar, in each group



RELATION OF DIET TO ORAL CONDITIONS

49

Chart No. 3
STAIN

Comparative percentages of the number of cases having stain, in each group

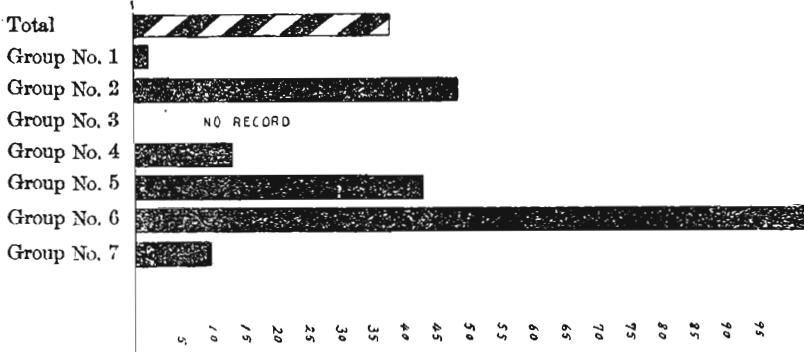


Chart No. 4
TOOTHBRUSH

Comparative percentages of the number of cases using toothbrush, in each group



Chart No. 5
DEPOSITS

Comparative percentages of the number of cases having deposits, in each group



Chart No. 6
ANTERIOR DECAY

Comparative percentages of the number of cases having anterior decay, in each group

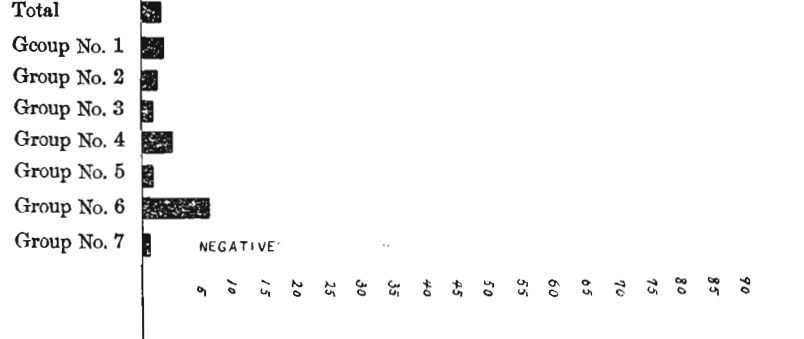


Chart No. 7

FORMER DENTAL WORK

Comparative percentages of the number of cases having had former dental work, in each group

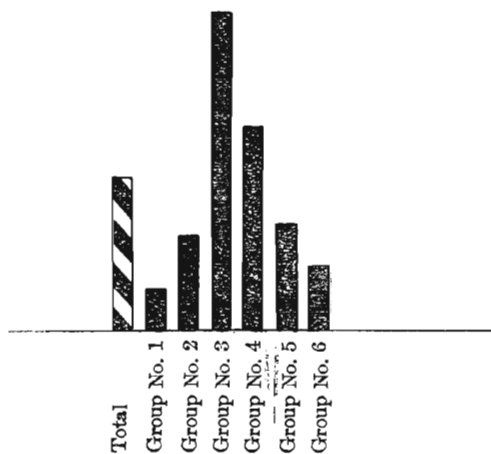


Chart No. 8

CARIES AND SUGAR

Percentages of cases having caries
Percentages of cases using sugar

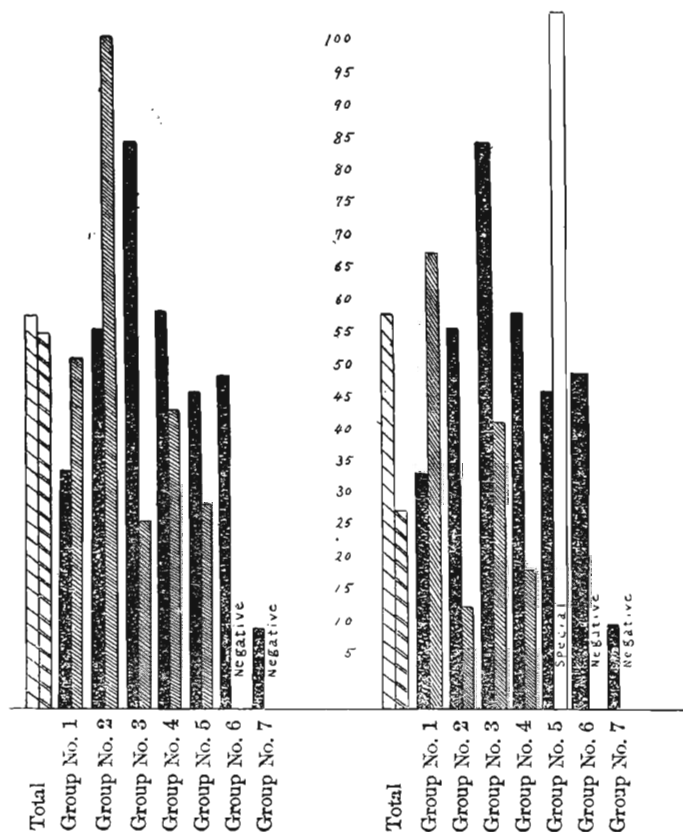
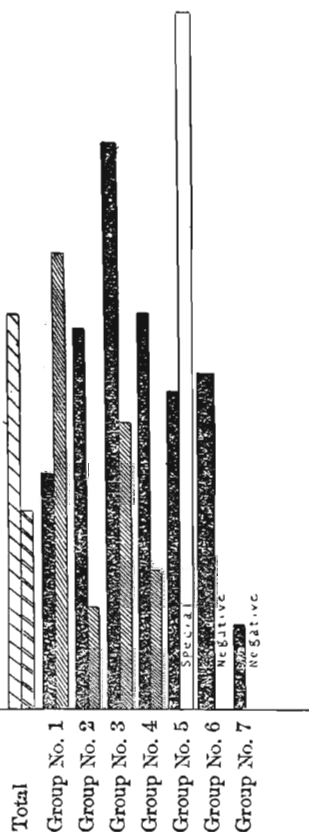
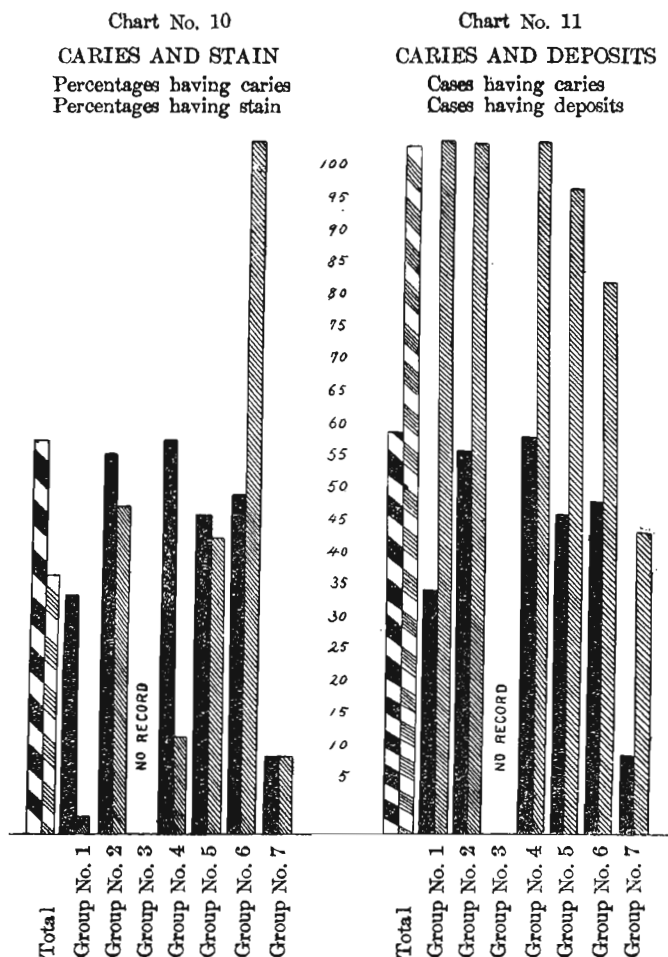


Chart No. 9

CARIES AND TOOTHBRUSH

Percentages of cases having caries
Percentages of cases using toothbrush





C. INTERPRETATION

Item No. 1.—AGE

In groups No. 1, No. 2, and No. 7 the ages were so constant that no account was taken as to their being under or over twenty-one years. In the other groups there was a wide variation of ages.

Item No. 2—SEX

Groups No. 1, No. 2, and No. 7 were of one sex exclusively. Though the women were generally more reluctant to appear for examination, groups No. 3, No. 4, No. 5, and No. 6 show a fair division of male and female.

Item No. 3.—CARIES

From our general observations, the percentages here seem too high for national averages. However, the figures represent the number of

patients having carious teeth, not the amount of caries. A great majority reported as positive for caries had no more than two or three cavities and these were not extensive. In group No. 1, of 55 boys having caries, 49 had not more than two cavities; that is, only 4% of the group had extensive caries. The cavities in the 49 were occlusal pits in molars.

Attention is called to the higher percentages of caries among the girls than among the boys.

The high percentage in group No. 3 was expected on account of patients coming to the clinic for the relief of pain. This could not be taken as an average for the country.

In groups No. 4, No. 5, and No. 6 the percentages are high enough to suggest that a greater number of those conscious of dental ills appeared for examination than those not. However the percentages are low compared with American, English or Japanese groups.

The percentages for American and British people are well known. Of statistics for nine Japanese groups of different ages and living conditions, examined by different men, in different parts of Japan, (reported to me by Dr. Nagira of Seoul) the percentages of caries ranged from 79% to 98.9% with an average of 89%. I would judge these to be accurate. Most of the references which I have found to Japanese diet and dental conditions are at fault. Janney write "according to the Carbohydrate-Acid Fermentation Theory, those races such as Japanese, living chiefly upon cereals, should suffer greatly from defective teeth. *Such is not the case.*" I consider 89% rather defective. Janney, (36-P. 556) Owre, (47-P. 90) Pickerill, (49-P. 296) Hellman, (26-P. 191) noted the carbohydrate diet of the Japanese people and none mentioned the use of fish. My observations of many Japanese homes, inns, and markets, both in Korea and Japan, would lead me to think that almost all Japanese people have some fish every day. A typical Japanese "guest meal" usually has from six to eight kinds of fish, half of them served raw.

In group No. 7 of ten boys from six to seventeen years of age, only one (aged six) had caries, a small pit cavity in an upper deciduous first molar.

Extensive caries was found only in a few cases. In group No. 3, nine had from four to seven molar teeth decayed. In group No. 4 two were found with all teeth carious.

There was a low protein content in all groups. Howe (25, 34, 31) has found no dental or bone changes in animal experimentation, where starch was substituted for protein, and he has suggested a high protein diet as a causal factor in caries. In contrast to this, the Eskimo, living on a high protein diet, is reported by all investigators as being remark-

ably free from dental lesions.

Pickerill also believed (49-P. 223) that the large amount of protein debris was one of the most important factors in the present prevalence of dental caries, *when it was mixed with fermentable carbohydrates.*

Dr. Nagira found an average of 48.8% caries among primary school children in Korea and also reports the incidence of caries consistently higher among Koreans in the cities than among those in the country districts. His findings in general coincide with ours.

Item No. 4.—ANTERIOR DECAY

These percentages are small and consistent in all groups, except in No. 6, here rising from an average of $2\frac{1}{2}\%$ to 9%; there is no apparent explanation. I do not recall having seen any cervical cavities.

Note that none of the children in group No. 7 had anterior decay.

Item No. 5.—DECIDUOUS DECAY

On account of the wide latitude of ages and the absence of deciduous teeth in the student groups the figures here are of little consequence.

Item No. 6.—SUGAR

Unfortunately our examinations were made of groups that had more than ordinary contact with refined sugar. The manner of this is clearly shown in the first groups. The boys had one foreign instructor with whom they rarely came into social contact. They reported 47% using sugar. The girls had about a dozen American teachers, with whom they came into frequent social contact, being served tea, cakes, and candy. They reported 91% using sugar.

Twenty-five per cent in the third group is about normal for those living in the capital city, but I think it is not to be relied upon as representing the percentage of sugar users among dental patients. Probably some did not understand our question.

Forty per cent in group No. 4 is also high. In all of these groups, however, the amount of sugar consumed would not average more than half dozen spoonful a week per person.

Groups No. 6 and No. 7 are typically native—no sugar except a little wild honey during the winter. Compare group No. 7, ten young native boys, with any ten boys in America; these Koreans had never tasted sugar.

I took up in the first chapter the matter of the importance of the combination of sugar with a food having an alkaline potential.

Item No. 7.—STAIN

The wide variation here, for which we have no explanation, suggests material for future study. The color was usually green. There would seem to be some relationship between stain and the use of the toothbrush.

Item No. 8.—TOOTHBRUSH USED

In all of the groups except No. 5, we mean an American style brush. They were of Japanese manufacture with a soft bristle, usually No. 2. (A "medium" American brush has about No. 5 bristle.)

The boys in group No. 1, more forward, adapting themselves quickly to importations, reported 61% using a toothbrush; the girls, more conservative and under group influence, reported only 13%. 38% in the clinical group, 18% in the island group, and none in groups No. 6 and No. 7 are as we would expect.

In the temple group, however, 94% conformed to a custom of that district of using as a "toothpick" and "brush" a wooden stick heretofore described. Thirty-nine per cent stain and 86% deposits do not speak well for the efficiency of the Buddhist brush.

The universal custom of rubbing the teeth with coarse salt held on the ball of the finger normally takes the place of our toothbrushes and dentifrices.

Item No. 9.—DEPOSITS

Deposits were consistently heavy in all groups. It should be noted that the group using no brushes, no dentifrice except salt, having the most simple diet, showed the lowest percentage of deposits.

The deposits were invariably salivary calculus.

Item No. 10.—GINGIVITIS

The percentages here were consistently high and conformed to our general observations. Where the figures fell below 90%, it was due to the number of young children reported in these groups.

Item No. 11.—PYORRHEA

The students showed only 4% and 3% on account of their youth.

Considering only those over twenty-one years of age, in group No. 3, 61% had pyorrhea, in group No. 4, 86%, in group No. 5, 86%, and in group No. 6, 100%.

It has been stated (22-P. 115) that "whether the cause of pyorrhea alveolaris be local or constitutional, microbic or dietary, monomicrobic or polymicrobic, bacterial or protozoan, all observers agree that irritation is fundamental in its etiology." The percentage of pyorrhea in Korea is very high, and although the cause is not known, attention is called to the irritations present. There is first, the "burning" of the mucous membrane by red peppers in the diet (this is of no slight degree), second, the irritation from traumatic occlusion and third, that from heavy precipitations of salivary calculus.

Beckwith and Morrison, (5) in a survey of 975 teeth in seventy-three male prisoners, with an average age of 32.1 years, (comparable with

our cases over 21), found only 56% pyorrhetic. This is a greater contrast than the figures indicate, for, by their description, the syndrome they called pyorrhea was more liberal and inclusive than ours.

Item No. 12.—ABRASION

No adequate study was made of abrasion. I believe it to be common in all groups, probably on account of the stone grit left in the grain by the crude methods of hulling and grinding.

Pickerill, discussing the "attrition of teeth in native races," (49-P. 300) points out that it is far more probable that the attrition is due to the mechanical effect of finer fibrous particles combined with the constant action of the acids of the fruits and berries. This may be so in Korea; it deserves further study.

Item No. 13.—MALOCCLUSION

I have no explanation of the wide variation in the percentages of malocclusion in the first two groups, 24% in the one and 88% in the other. It is consistently common in the other groups.

Item No. 14.—IRREGULAR TEETH

In three groups we noted the cases where the teeth were noticeably out of alignment. It was always due to crowding, not to spacing, and will be considered more in detail under "impactions".

Item No. 15.—PROTRUDING ANTERIORS

This was not noted in all groups. A general observation of Korean faces suggested an unusually large number having a typical anterior protrusion. Leigh (37-P. 885) examined Eskimo skulls and reported the frequent occurrence of a wide, oversized arch and teeth rotated to fill the space. In contrast to this I would say the typical Korean skull has a high narrow arch and the teeth crowded, with frequent impactions.

With so many writers reporting this condition due to thumb sucking, bottle nursing or some such habit causing a muscular compression of the jaws during infancy and early childhood, I offer not the proof, but the suggestion that among Koreans, it may be due to continued late nursing. No cow milk being available, the Korean child, in order to change from mother's milk to a rather coarse diet, must be weaned gradually. Breast nursing is often continued until the age of three or four. (Avison, the pediatrician at Severance Hospital, reports the average period of lactation in the Korean women as three years). (Personal communication). In addition to the late nursing, many children acquire the habit of sucking the dry breast, much as a child might use a pacifier or suck the thumb.

Item No. 16.—MOUTH BREATHING

Further study here will be of interest. We noted it in only one

group. "Colds" from exposure in the severe winters and insufficient heating of the houses, cause an unfortunately high percentage of mouth breathers. Enlarged and infected tonsils are common. Tipton of Korea made an observation, however, that he did not find excessive adenoid tissue accompanying enlarged tonsils.

Stillman and McCall say abnormal habits such as mouth breathing contribute to the production of gingivitis. Colyer says, "It is the cause of half the diseases of the teeth." Our observations would lead us to think it had much to do with periclasia and little to do with caries.

Pickerill (49-P. 165) discussing "The Effect of Common Colds" states, "the salivary flow is decreased, depriving the teeth of protection at a time when it is much needed" and that "colds undoubtedly have a causal relationship to the incidence of caries."

I doubt this to be true in Korea. Probably no Korean children are free from nasal colds and subsequent mouth breathing during the winter months, yet the incidence of caries is remarkably low.

Item No. 17.—IMPACTED THIRD MOLARS

This fault is very common—17% of all clinic patients and 23% of these who were over twenty-one years of age. Fistulae to the outside of the face are frequently seen and occasionally a bilateral case.

OTHER IMPACTIONS

I have noted under items No. 14 and No. 15 the frequent crowding of the teeth. In group No. 1 there were two cases with impacted lower left second bicuspid, one with an impacted upper cuspid and two with upper central supernumerary teeth. In group No. 3 a male patient about thirty years of age had an upper and lower second molar impacted.

In group No. 2 nine girls (of 345) had impacted lower second bicuspid, five had unerupted lower second bicuspid, one had an unerupted lower second molar, nine had impacted lower third molars, one had an impacted upper third molar, and two had supernumerary upper centrals.

Compare this with Leigh's findings (37-P. 887) in Eskimo skulls in which there was in 324 crania, not one occurrence of impacted lower bicuspid and only one bicuspid out of line of occlusion.

I have no statistics on American cases of impacted lower bicuspid, but the fault would seem to be more common among Koreans.

Item No. 18.—FORMER DENTAL WORK

These percentages represent the number of people having formerly gone to a dentist for service. The figures are consistent, 5% of the boys, 12% of the girls, (who had twice as much caries as the boys,) 44% of the clinic patients, 27% of the island group, which had access to easy travel, only 14% in the mountain temple group, in the isolated mountain group

8%, and the boys in group No. 7 did not know what a dentist was.

Item No. 19.—RESIDENCE

This last item is of no importance in the present survey except to show that 86% of our clinic patients were residents of the city.

PART 2. CORRELATIONS

A. TABLES AND CHARTS

TABLE NO. 2

Groups	No. 1	%	No. 2	%	No. 3	%	No. 4	%	No. 5	%	No. 6	%
Caries pos.	55		233		266		86		57		40	
Toothbrush pos.	27	49	36	15	103	23	17	19	2	3	0	
Caries neg.	118		223		79		79		80		49	
Toothbrush pos.		28	22	9	28	35	11	13	6	7	0	
Caries pos.	55		223		266		86		57		40	
Sugar pos.	38	69	225	96	81	30	37	43	12	21	0	
Caries neg.	118		228		79		79		80		49	
Sugar pos.	43	36	288	86	14	17	28	35	24	30	0	
Over 21 years of age					267		70		44		49	
Caries pos.					201		48		25		46	
Pyorrhea pos.					111	55	42	87	21	84	26	100
Over 21					267		70		44		49	
Caries neg.					66		22		18		23	
Pyorrhea pos.					35	53	19	86	17	94	20	

CHARTS NO. 12 AND NO. 13

The columns do not vary, to an extent to justify an assumption of consistent relation of caries, either positive or negative, with any of characters with which it is associated.

TABLE NO. 3

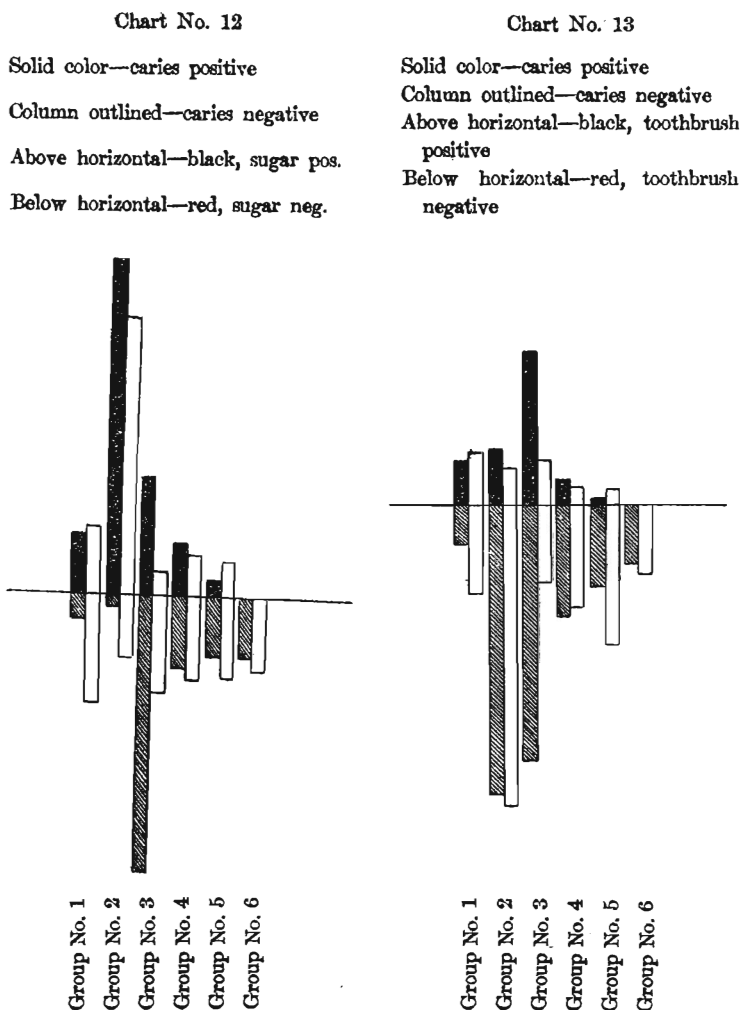
Correlation of Caries and Pyorrhea in Patients Over 21 Years of Age

Cases—Not percentages

Group	A Caries and Pyorrhea	B/C Either Caries or Pyorrhea	B Caries & no Pyorrhea	C Pyorrhea & no Caries
No. 3	111	125	90	35
No. 4	43	25	6	19
No. 5	21	21	4	17
No. 6	26	20	0	20
Total	200	191	100	91

Chart No. 12 and No. 13

FIGURES SHOW NUMBER OF CASES IN SCALE



There was no evidence here to support the theory of dissociation. The two characters were as apt to be concomitant as not. The totals in the two columns A and B plus C are nearly equal. It is coincidental that the totals in columns B and C are also about equal. In group No. 5, the two divisions A and B plus C were exactly equal and the other groups showed little variation. In group No. 4, of two patients having all teeth carious, one, female, 67 years of age, negative for sugar, and the other, male, 26 years of age, and positive for sugar, both had pyorrhea.

Beckwith and Morrison (5) found a tendency for pyorrhea and caries to occur dissociated from each other. Below are their records.

<i>Characters</i>	<i>Number of teeth</i>	<i>Percentage</i>
Both pyorrhea and caries	27	4.9
Pyorrhea without caries	517	93.8
Caries without pyorrhea	7	1.3

Note—Their total amount of caries is very low for this type of patient and must have either excluded filled teeth or teeth extracted for caries.

TABLE NO. 4

Correlation of Male and Female as to Caries
Positive and Negative

Cases—Not Percentages

Groups	No. 3	No. 4	No. 5	No. 6
Caries	262	86	57	40
Male	129	46	30	26
Female	133	40	27	14
Caries	83	79	80	49
Male	48	57	54	29
Female	35	22	26	20

There was nothing to show any higher susceptibility in one sex than in the other.

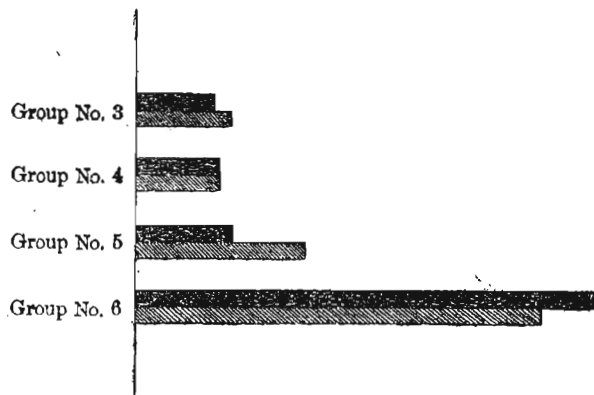
Chart No. 14

CORRELATION OF CARIES AND PYORRHEA

Columns in pairs, and for groups No. 3 to No. 6

Equals number of cases having both caries and pyorrhea

Equals number of cases having either caries or pyorrhea



CHAPTER IV. SUMMARY

1. That the Korean people are now changing from a comparatively simple diet, with little sugar and the salivary depressants, to one containing them, and that an unusual opportunity to investigate the factors of the use of refined sugar, the presence of *bacillus acidophilus*, vitamin deficiencies, and the calcium metabolism, and their importance in the etiology of caries.

2. That the percentage of total caries is comparatively low and the percentage of impactions and periodontoclasia correspondingly high.

3. That the typical Korean diet is apparently satisfactory for the formation of good teeth and that no results of this investigation prove the dependence of caries upon a deficient diet.

4. That the percentage of caries in some groups seems to vary according to the amount of sugar eaten, yet the dependence of one upon the other is not proved, for the amount of caries was relatively high in groups having no sugar.

5. That dissociation of caries and pyorrhea was not apparent; those having pyorrhea were as apt to have caries as not.

BIBLIOGRAPHY

1. Alkin: Diet and dentistry. *Dental Science Journal of Australia* 1924, 502.
2. Anthony: The role of dietetics in the development and maintenance of the masticatory apparatus. *Cosmos*, Nov., 1926.
3. Anthony: Bacterial factors in pyorrhea alveolaris; microbic changes in saliva. *J.A.M.A.* Vol. 31, 1923.
4. Arbuthnot-Lane: Pyorrhea. *Dental Science Journal of Australia*, 1924, 124.
5. Beckworth and Morrison: The occurrence of clasmotocytes in oral conditions related to pyorrhea. *J.A.D.A.* Jan., 1926, 38.
6. Beriman: Some relations of the teeth to the endocrine glands. *Cosmos*, Jan., 1925.
7. Black: Pathology and treatment of pyorrhea. *Dental Science Journal of Australia*, 1925, 167.
8. Boys: Teeth decay and human decadence. *Dental Science Journal of Australia*, 1925, 145.
9. Boys: Dental disease in relation to diet. *Dental Science Journal of Australia*, Sept., 1924.
10. Boswell: Diet our best therapeutic ally. *J.A.D.A.* Jan., 1926.
11. Breese: Vitamins and dental caries—a criticism. *Dental Science Journal of Australia*, 1924, 465.
12. Bush: Dental efficiency in its relation to bodily and mental efficiency. *Dental Science Journal of Australia*, 1924, 396.
13. Bunting: Heredity. *J.A.D.A.*, *Dental Science Journal of Australia*, 1925, 238.
14. Chichester: Pyorrhea in general and particular. *Pacific Dental Gazette*, Nov. 1926.
15. Colyer: Dental diseases among certain Central African tribes. *The Dental Record*, Sept. 1917.

16. Creese: Food in relation to the use of the teeth and their resistance to dental caries. *Dental Science Journal of Australia*, 1924.
17. Davis: The cause and effects of mouth breathing. *Dental Science Journal of Australia*, 1924.
18. Deeks: The influence of nutrition on the teeth. *Cosmos*, Nov. 1926.
19. D'Alise: Syphilis, tuberculosis, rachitis and malocclusion. *Pacific Dental Gazette*, , 512.
20. Dunne: The teeth, health and diet. *Dental Science Journal of Australia*, 1925, 66.
21. Fones: Prenatal diet and its relation to the teeth. *Dental Science Journal of Australia*, 1924, 126.
22. Hall and Westboy: Bacterial factors in pyorrhea alveolaris. *Cosmos*, Feb., 1925.
23. Handley and Reed: The influence of diet on dentition. *British Dental Journal*.
24. Hartzell: Diet and nutrition with reference to the teeth. *Cosmos*, 1924, 1205.
25. Hall: Dental diagnosis in relation to systemic disease. *Dental Science Journal of Australia*, Dec., 1924.
26. Hellman: Food and the teeth. *Cosmos*, Feb., 1925, 191.
27. Hecht: Fruit. *Dental Science Journal of Australia*, 1924, 515.
28. Heath: Mens sana in corpore sano. *Cosmos*, Sept., 1925.
29. Hooker: A serious etiologic aspect of pyorrhea. *Cosmos*, Jan., 1925.
30. Holborn: Chronic marginal gingivitis; its commonest causes. *British Dental Journal*, 1919, 329.
31. Howe and Keniston: The salivary factor in relation to dental caries. *Cosmos*, Sept., 1918.
32. Howe: Food accessory factors in relation to the teeth. *British Dental Journal*, 1921, 345; 1918, 917.
33. Howe: Diet as a factor in dental disease. *Oral Health*, April, 1926.
34. Howe: Diet, health and dentistry. *The Dental Outlook*, June, 1926.
35. a. Ibid: Pathologic effects of lack of vitamin A and of antirachitic vitamin. *J.A.M.A.* Sept., 1923.
35. b. Ibid: Process of dentition and effect on occlusion. *Cosmos*, Dec., 1923.
36. Janney: The influence of the endocrine glands upon the dentition. *Pacific Dental Gazette*, Oct., 1923, 556.
37. Leigh: Dental pathology of the Eskimo. *Cosmos*, 1925, 804.
38. Love: Cancer and carious teeth. (*British Dental Journal*) Abstracts in *Dental Science Journal of Australia*.
39. Masaki: Studies on vitamin deficiency disease. Tokyo, Japan.
40. Mellanby M.: The influence of light, in relation to diet, on the formation of teeth. *British Dental Journal*, 1924, 545.
41. Mellanby M.: The effect of diet on the structure of the teeth. *British Dental Journal*, Sept., 1924, 1031.
42. McClelland: Dentifrices and the saliva. *Cosmos*, 1924, 751.
43. McCollum: Deficiencies in the diet as related to nutrition and growth. *Cosmos*, June, 1921.
44. McCollum and Simmonds: The newer knowledge of nutrition.
45. McCall and Box: The pathology and diagnosis of the basic lesions of chronic periodontitis. *J.A.D.A.*, July, 1925, 1300.
46. Nichols: Dental caries. *British Dental Journal*, Jan., 1921.
47. Owre: Diet and dentistry. *J.A.D.A.* Jan., 1926.
48. Peacock: Sugar and the teeth. *British Dental Journal*, 1921, 1148.
49. Pickerill: The prevention of dental caries and oral sepsis.
50. Power: A consideration of frequent causes of malocclusion. *International Journal of Orthodontia*, 1919, 239.

51. Printz: The relation of oral secretions to dental caries. *Cosmos*, March, 1918.
52. Printz: A few aphorisms concerning pyorrhea alveolaris. *Cosmos*, 1924, 129.
53. Robertson: Tarter. *Texas Dental Journal*, Nov. 1916.
54. Rumsey: Diet, calcium metabolism and the teeth. *British Dental Journal*, Jan., 1921.
55. Spalding: The relation of periodontoclasia, calcium metabolism and dietary and systemic disease. *J.A.D.A.*, 1925, 952.
56. Stillman and McCall: Clinical periodontia.
57. Stone: Deposits found on the teeth. *Dental Record*, 1920, 539.
58. Stefanson: People who do not like sugar. *Hygeia*, May, 1923.
59. Talbot: Interstitial gingivitis. *International Dental Journal*, April, 1896.
60. Thoma: Teeth, diet and health. Century Company, 1923.
61. Wells: Food deficiency as a factor influencing the calcification and fixation of the teeth. *International Journal of Orthodontia*, 1919, 223.
62. Wiley: Sugar and teeth. *New Zealand Dental Journal*, 1921, Vol. 16, 230.
63. Wheatley: Investigation in elementary schools. *The Dental Summary*, 1921, 792.
64. Wood: A consideration of induced malocclusion as a factor in pyorrhea alveolaris. *Dental Items of Interest*, XII, No. 9.
65. Wolback and Howe: Deficiency diets in animals. *J.A.D.A.*, Nov., 1926.
66. VanBuskirk: The composition of typical Korean diets. *Japan Medical World*, June 15, 1924, Vol. IV. No. 6.
67. VanBuskirk: Diet and good health. Research Department of Severance Union Medical College.
68. VanBuskirk: Studies on the diets of the Korean people. *The China Medical Journal*, July, 1921.
69. Ziesell: The treatment of pyorrhea. *Cosmos*, 1924, 882.
70. Annual report on reforms and progress in Chosen.
71. Tressler and Wells: The iodine content of seafoods. Bulletin Mem. S-252, U. S. Department of Commerce, Bureau of Fisheries, Dec. 18, 1923.