DENTAL

DENTAL DISEASE

ON

NAURU ISLAND

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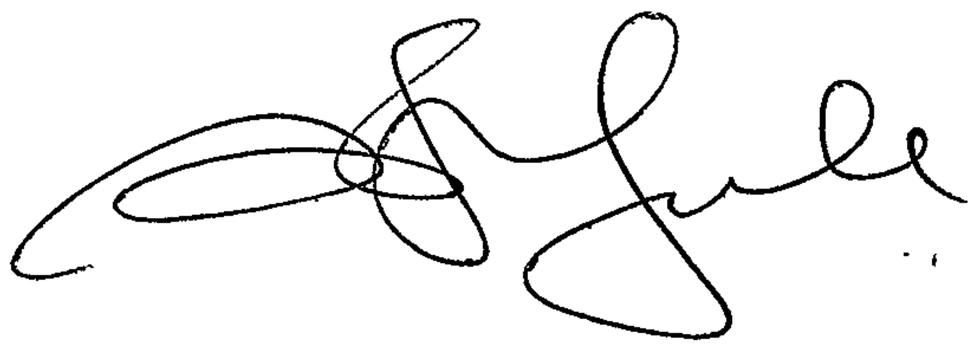
A Thesis submitted in partial
requirement for the degree of
MASTER OF DENTAL SURGERY.



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PREFACE

In 1966 a study of some common dental diseases was undertaken on the island of Nauru, Central Pacific. A dental epidemiological survey was patterned on the WHO protocol, Technical Report Series No. 207[54] and Technical Report Series No. 242[55].

The aim was to observe the prevalence of dental caries, periodontal disease, other dental conditions and dietary patterns. At the same time it was thought that it would be possible to compare examination results with those of an earlier examiner, P.B. Cadell,who carried out a survey in Nauru in 1956.

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INTRODUCTION

On accepting the position as Dental Officer within the Administration of Nauru, permission was obtained to spend unspecified time in research and study of the dental conditions that might be found in the Nauruan people.

Professor N.D. Martin suggested a dental epidemiologic survey may be best implemented in such a remote area and this was to prove correct. The climate, hot and humid, leads to a rapid deterioration of all delicate instruments and so, refined equipment for such techniques as standardised X-rays, tissue culture, biopsy and saliva tests were not practicable. The advent of airconditioning would alter this.

It was decided to observe and record some of the more common dental conditions, namely, dental caries and periodontal disease.

Nauru is a phosphate bearing coral atoll in the Central Pacific and this presented an opportunity to examine a reasonably isolated group of Pacific Islanders, who number 2,038.

As earlier workers had recorded their impressions of the Nauruan dental state it was hoped to compare their findings with any current ones.

Indices used were those of the WHO Technical Report Series Nos. 207[54] and 242[55]; df (decayed and filled primary teeth) and DMF (decayed, missing and filled permanent teeth) for dental caries, PI (Periodontal Index) for periodontal disease and for oral hygiene the Oral Hygiene Index-Simplified (OHI-S) was used instead of the Oral Hygiene Index (OHI) recommended by WHO.

The literature was examined with special reference to the epidemiological methods used and the findings of other dental surveys of some remote peoples and Pacific Islanders.

This thesis presents a brief review of the literature concerning these subjects and presents the methods and findings of a dental health survey on 1,420 Nauruans five years of age and over who inhabit an isolated coral atoll in the Central Pacific.

REVIEW OF LITERATURE OF PEOPLES INHABITING THE PACIFIC BASIN

The major dental studies carried out in the Pacific Islands and some countries of the Pacific Basin are reviewed and presented chronologically. The discussion section deals in further detail with those surveys where direct comparison with the present Nauru study is possible.

Pickerill & Champtaloup (1913[38]) examined Maori "children between the ages of 4 and 15 (approximately)" for bacteriology content in relation to dental caries. The examination was restricted to the patient's saliva. No record is given as to the dental caries or periodontal condition of the teeth nor were yearly age group numbers presented.

Hawaii in 1930 (Jones, Larsen & Pritchard 26, 27, 28, 29) was the source of extensive clinical, chemical and histological dental examinations. The investigations recorded the type of decay, relation between caries and malnutrition, age incidence, race incidence, effect of caries on the adult group and predisposing and exciting factors of dental caries. A large sample of 1,761 children was examined and caries was classified as follows:

O	-	Does not occur
±	-	rarely occurs
+	-	occasionally occurs
++	-	often occurs
+++	-	more often occurs
++++	-	most often occurs

Dental caries was presented in year groups from age 1 to age 6, as,

a. percentage of children with caries;

b. the average number of carious and non-carious teeth.

In the 5 - 6 year-old group 91.5% of the children had caries and there were 5.9 carious teeth per child. Ninety per cent of the children examined were classified as "Orientals" (people of basic Japanese ancestry).

A condition called "Odontoclosia" was also recorded and was found to be very prevalent in the deciduous teeth. The authors state "No doubt the lesion occurs elsewhere and has been regarded as ordinary dental caries". Dental caries incidence was not different in isolated rural and more densely populated towns (where "cheap candies and soda-pop are to be had at every turn").

The diet was discussed thoroughly - the examiners feeling confident that certain groups isolated on plantations purchased only at the one store and so enabled the examiners to accurately assess the eventual diet. "Jams, jellies, syrup, cake, cookies and sweet breads of all kinds together averaged six ounces per person per month."

Oral hygiene was discussed but not recorded - ("oral hygiene was not practised to any extent"). An attempt was made to correlate diet and dental caries. On their assessments of diet and dental caries the authors found "certain diets that contain no milk and are extremely high in carbohydrate have been compatible with sound enamel over a period of hundreds of years. Candy and sweets, per se, do not appear to be etiologic factors in the high incidence of dental decay in Hawaii".

Further histological study led to the conclusion that "diets of children three years of age or older, composed of ordinary foodstuffs and potentially basic in reaction, were invariably associated with sound enamel or arrested decay".

Again in 1934, Jones, Larsen & Pritchard[30] examined diet, health and caries incidence in an attempt to find the cause of the apparent increase in dental caries. They observed "the remnant of Polynesians living to-day who cling to their ancient food customs still have 'splendid physiques and beautiful teeth' and are far superior in these respects to their city cousins or any national group residing in the Territory".

Ferguson (1934[16]) conducted a dental survey in Samoa involving 2,257 children in yearly age groups from 5 to 20 years and examined both deciduous and permanent dentitions. He recorded:

Number of persons with cavities

Total number of cavities per group

Gingivitis

Calculus

Stain

Malocclusion

There was no mention as to how dental caries was assessed or what aids were used to arrive at the confirmation of a carious lesion.

The stain was observed to be "rather heavy, with a somewhat rough appearance and of a yellowish green, very similar in colour to chlorine gas".

Calculus was found in 419 of the number examined. "In no case were the deposits heavy, many cases being so light that they could easily be removed by a toothbrush." Again no definition of calculus nor degree of involvement was recorded. The deposits removed by toothbrush may not have all been calculus and if so his figure for calculus presence might not be accurate.

Gingivitis was not discussed as to the type, location or degree, nor was gingivitis defined.

Further to the 2,257 children examined a sample of 50 adult Samoans was examined to determine an index of dental caries, and 2.6 teeth per person were classified as 'defective'.

A later reference is then made to 98 cases out of 100 "older Samoans" suffering from "periodontoclasia".

Kirkpatrick (1935[31]) visited Manus Island and a reasonable cross section of the island was examined for gingival disease, dental caries and odontoclasia. Dental caries was observed in 49 of the 1,976 Manus Islanders and in those affected there was an average of approximately 2 carious teeth per person. The caries was often arrested. Dental caries was not defined but the group was divided into 1,020 sago eaters and 956 taro eaters. There was no significant difference in caries incidence between the two groups.

Due to the locations of these groups it was apparently easy to ascertain those who used a sago or taro diet.

Of the 1,020 sago eaters 521 were under 20 years of age and the total number of carious teeth for this group was 60. Yet of the total 1,020 sago eaters the total number of carious teeth was 62. This means 499 20-year-olds and over had only

2 carious teeth between them. It would have been interesting to know the number of missing teeth or whether "arrested caries" was not recorded as caries. There was no difference in dental caries incidence between coastal and inland dwellers. No mention was made as to method of examination and recording techniques.

In 1937 Kirkpatrick[32] presented his findings from the earlier Manus visit and reported on "(a) gingivitis in all its forms, (b) recession of the gingival attachment, (c) suppurative periodontitis and (d) the presence of tartar and other oral abnormalities". He observed an investigational complication of the presence of calculus ("arising from betel chewing") and results of smoking. A comprehensive report on the preparation of sago and taro was given as were the amounts eaten daily.

A table was presented that showed:

1. 545 persons had "Recession of the Gingival Attachment"
2. 405 persons had "calculus formation"
3. 459 persons had "chronic gingivitis"
4. 66 persons had "Acute or subacute Vincent's infection"
5. 423 persons had "suppurative periodontitis"

None of these above five conditions were defined or described nor were methods of examination presented.

Kirkpatrick demonstrated an apparent difference between taro and sago eaters in the following conditions:
acute or subacute Vincent's infection, suppurative gingivitis, crowding of teeth and traumatic occlusion. This was attributed

to the better muscular and arch development of the taro eaters because taro eating requires more masticatory effort than the prepared sago.

Bedkober (1938[5]) examined "about one thousand five hundred" of the Nauru Islanders and found 37.5% of all adults had definite dental caries present with the females showing a greater "caries degree" than men.

It was recorded that 19.9% of the entire adult population suffered periodontitis. "All states of pyorrhoea are met....."

Localised and generalised conditions were observed and shallow simplex to deep narrow complex pockets were mentioned.

As with earlier workers neither dental caries not periodontal conditions were defined nor was the method of examination presented.

Graphs of caries and periodontitis were listed in the various districts and Bedkober presented the theory that the more remote areas suffered less caries but more periodontal disease, due to the distance required to travel to food stores. He presumed those who lived close to the stores ate more European style foods.

In discussing the Nauruan diet Bedkober felt "They like very sweet drinks".

It was observed that oral hygiene appeared poor and that the only attempts to clean the teeth were by those living near the beaches where fine sand was to be found.

Further on it was observed "the cusps of molars in most Nauruans ,show very little signs of wear".

In discussing periodontal disease mention is made

"of the Nauruans, about 80% have a large 'overbite' without in most cases a compensating 'overjet'. In central protrusive bite the anterior 12 teeth are the only teeth occluding".

Further on it is reported the incidence of periodontal lesions is greater in the aged natives.

Oral hygiene is mentioned under the title "Uncleanliness" where "the general uncleanliness of most of the Nauruan mouths would appear to give every assistance to the onset of the disease. The presence of gingival calculi is very common and is recognised as definitely a local predisposing cause".

The next section of Bedkober's article deals with Nauruan children where he observes "children up to the age of about 9 years are almost entirely free from caries".

He states deciduous teeth do not exhibit dental caries. When caries is observed in permanent teeth it is usually not before 16 years of age.

No tables have been presented to support the above statements regarding dental caries, periodontal disease, calculus or oral hygiene. Two graphs were shown:

1. to demonstrate the incidence of caries in men and women in districts.
2. The incidence of caries and pyorrhoea in districts.

Saunders & Taylor (1938[46]) presented a survey of 36 Maori children from an isolated village in New Zealand. Their ages varied between 4 and 14 years. Calculus was present in 22 persons and gingivitis was present in 34 cases. "Of the 887 teeth examined, 223 or 25.14% exhibited active caries to a greater or lesser extent. Only one perfect set of teeth was

found...." The diet was then discussed and it was observed that white flour has supplanted the natural fern-root. This change of diet being held responsible for the apparently high incidence of dental caries and gingivitis. Definitions and examination methods have not been presented.

Williams (1939[53]) examined 1,541 Western Samoan children. Of this group 521 children lived in a remote area seldom visited while the remaining 1,020 children lived in a relatively urban area.

The age range of the remote group was 4 - 12 years and the urban group from 5 - 24 years.

The author had problems with ages: "It was impossible for many children at the native schools to give me any idea in years of their age. I therefore put down what I judged to be an approximate age."

Dental caries was presented in two ways: 1. as a percentage of total number of teeth examined which showed signs of decay. 2. Percentage of children examined having all sound teeth.

The three urban schools gave very divergent figures for the above; this was to be expected as the age range of the first school was 5 - 16 years, the second school 5 - 20 years and the third school 13 - 24 years. As noted previously the "remote" school ages ranged from 4 - 12 years. The closest comparison between remote and urban groups would be the 5 - 16 years and 4 - 12 year schools and the doubt engendered by the 13 - 16 year-olds of the urban group would make valid comparisons impossible.

Oral hygiene was observed for each school group and reported as percentage of children in the classifications clean, partially clean and neglected. The remote school was not examined for oral hygiene but the author gave a general opinion that this school had "very few neglected mouths".

Calculus was defined as salivary and subgingival and these two types would be representative of supragingival and subgingival calculus as presented in the WHO Technical Report Series 207 (1961[54]).

"The presence of calculus was observed in roughly 50% of the mouths examined in Apia children 13 years of age and over." (The Apia children comprised the 3 urban schools.) "From 13 to 16 years the most frequently seen was the subgingival calculus and above 16 years of age deposits of salivary calculus were met with more frequently."

This was the only method of recording calculus presented by the author.

The periodontium was examined and the gingiva and supporting tissues undergoing inflammation and degeneration classified into 5 stages.

Stages:

1. Detachment of gum from the enamel of the teeth.
2. Swelling, congestion and mobility of gum.
3. Bone becomes involved.
4. Deep pockets formed and necks of teeth become exposed.
5. General loosening of the teeth.

For the Apia children the condition of the soft tissues

was presented in table form as:

Normal

Fair. Slight Congestion Stage 1.

Stage 2.

It is to be assumed the above 3 levels represented the extremes in soft tissue conditions and that stages 3, 4, and 5 were not observed.

As with the calculus examination the remote group were not examined but the author states... "I can definitely state that the greatest percentage examined were normal".

Diet was examined and, as with Kirkpatrick, Williams felt confident he could with reasonable accuracy assess the dietary intake. Williams quotes figures for imports of sugar, flour and tinned food. He does not mention what proportion of this is sent off the islands via the various trading vessels that I would assume call at Apia.

Price (1939[39]) observed the inhabitants of several Pacific Islands in 1934. His methods of examination were not explained in detail and the dental caries experience was expressed as the percentage of teeth affected. He found variations in tooth decay from 0.6% in the most isolated groups to 33.4% in the modernised groups and attributed the altered diet the basic cause of increased dental caries experience.

Sinclair, Cameron & Goldsworthy (1950[48]) observed three groups of New Guinea natives. Here the methods of examination were fully presented, thus making it possible for valid comparisons with future surveys in New Guinea.

As with most observers the age problem was encountered and so six groups (A to F) were designated to represent the following ages:

Group A	-	1 - 5 years
Group B	-	6 - 10 "
Group C	-	11 - 15 "
Group D	-	16 - 29 "
Group E	-	30 - 44 "
Group F	-	45 and over.

Caries incidence was recorded by three methods: "on the basis of persons", "on the basis of standing teeth" and "on the basis of surfaces of standing teeth".

The problems of dividing the cause of missing teeth and remaining roots were discussed. 331 persons were examined and persons free of caries and persons with caries were listed in separate columns. Numbers for each age group and percentage of subjects caries-free were also tabulated.

Further tables listed the age group numbers related to number of teeth standing with number of carious teeth and listing this as a percentage. Tables were also presented for the number of standing and carious surfaces and the percentage carious surfaces per tooth.

The Decayed and Missing teeth were recorded as the "Mean No. DM teeth per person" for the six age groups.

As can be seen from the above this survey approaches the guide lines advocated by the WHO Advisory Committee in the WHO Technical Report Series No. 242 (1962[55]).

Also presented for each age group was the "frequency with which the various surfaces of the teeth have been affected

by caries".

The oral flora and diet was examined.

The probable cause of missing teeth was well discussed and teeth missing because of a probable periodontal cause were separated from those assumed missing from caries. The number of teeth missing and the probable causes were tabled under 6 headings:

Caries

Periodontitis

Trauma

Unerupted

Congenitally absent

Unknown

The basic problems of comparison of this survey and the thesis survey are the use of radiography, artificial illumination and age group classifications. The numbers of many groups in the New Guinea survey were low for valid comparison with the thesis survey.

Faine & Hercus (1951[15]) examined 365 people "chosen at random in sixty-six family groups from the village of Arorangi" on the island of Rarotonga, in the Cook Islands - these were chosen to be representative of the 6,000 inhabitants of Rarotonga.

Of the 337 with teeth 4% (12) were free from dental caries. Caries was recorded "according to a modification of the Medical Research Council System." Filled and extracted teeth were listed separately.

The gingival condition was presented in a table

"Condition of gums of subjects of Survey". The gingival state was graded 0 to 5 where:

0	-	gums healthy
1	-	commencing gingivitis
2 & 3	-	progressively increasing gingivitis and early pyorrhoea
4 & 5	-	severe and gross pyorrhoea.

As with other surveys periodontal definitions are lacking - for this reason alone valid comparisons with the thesis survey are not possible.

Gerry, Smith & Calton (1952[17]) examined 1,346 persons from three separate villages and the dental clinic on Guam. Caries was reported as DMF. Both the primary and permanent teeth were included in calculating the DMF score as distinct from the DMF scoring system in the thesis survey. Method of examination was similar to that of the thesis survey and numbers are adequate. The Guam 12 year-olds had a "DMF" of 4.2 and the Nauruans' 12 year-olds' DMF is 3.2 Through the ensuing 13 - 19 year-old groups the Nauru thesis survey is consistently scoring lower DMF than their Guam counterparts.

In this age grouping the deciduous tooth component should not affect DMF and it is possible to discuss this lower score from the Nauru survey from two angles: a. the examiner variation is unknown; and b. the possible dietary variation being affected by the habit of betel chewing and the apparently large intake of imported refined carbohydrates. The Guam groups had extreme variations in DMF scores, the betel chewers being very low, e.g. the 14 year-old Agonce betel chewers

recorded a DMF of 3.3 while the 11 year-old clinic patients recorded a DMF of 9.4. The total group score of 6.2 compares with a Nauru score of 4.6. I feel examiner variation and/or diet would have to account for the difference.

McDowell (1953[36]) examined Cook Islander children taken from four separate islands. Due to difficulty in recording ages there were two age group tables presented. The first to illustrate dmf from random-chosen children who were reputedly aged 5 - 11 years, e.g.:

Island of Atiu - 43 children examined, average age per child 11.2 years, and average dmf per child 6.4.

The second table is aimed at the 6 - 15 year-old groups and a DMF score is given, e.g.:

Island of Atiu - 49 children examined, average age per child is 12.3 years and average DMF per child is 2.7.

A third table attempts to compare the dmf + DMF values of the different islands of the 5 - 15 year-old groups. The total number examined from Table 1 (ages 5 - 11) was 226; Table 2 (ages 6 - 15) was 346 and Table 3 (ages 5 - 15) was 360.

It can be seen from this confusion (no attempt was made to explain the reasons for this age grouping) it is impossible to compare these results with the thesis survey.

Hubble (1954[25]) examined two areas in Papua. Caries incidence was recorded and the method described. 200 persons were examined and caries was recorded as a percentage of people where caries was observed. Also the incidence of caries as

related to individual teeth was recorded. Nine age groups commencing at 10 years were used:

Group A	-	10 - 15 years
Group B	-	16 - 20 years
Group C	-	21 - 25 years
Group D	-	26 - 30 years
Group E	-	31 - 35 years
Group F	-	36 - 40 years
Group G	-	41 - 45 years
Group H	-	46 - 55 years
Group I	-	56 years & over

Valid comparisons with the Nauru survey are not possible on the grounds of different ages and scoring indices being used.

Davies (1956[11]) examined 472 inhabitants of Pukapuka Island for malocclusion. Again in (1956[12]) he reported on the periodontal condition of 497 persons on Pukapuka. Criteria for assessment ranged from Nil - no gingivitis in any region of the mouth-through scores of 1, 2, 3 and 4, of which 4 was classified as "severe gingivitis with associated generalised periodontitis". He listed 272 of this group as NIL or "No gingivitis in any region of the mouth". No methods and materials are presented in this survey nor is gingivitis defined, and because of this comparisons with the Nauru thesis survey are not practicable.

Calculus formation was assessed but criteria differed from those of this study.

Cadell (1958[9], 1959[10]) described dental conditions

in the Nauru Islanders. Dental caries was observed in 416 children and dmf, DMF scores were combined. Children were placed in age groups by year. This was allowed for in the present survey and only for the reason of comparison with Cadell were the dmf and DMF combined. Cadell followed the system of Davies in assessing periodontal disease and calculus formation. As mentioned previously, comparison with the present survey of calculus and periodontal disease was not possible because different criteria and age groups were used.

Erana & Macapanpan (1965[14]), while discussing dental health problems in the Philippines, grouped 6 - 7 year-olds and gave a DMF value and then presented a group of 12 - 14 year-olds with a DMF value per person.

In 1960, 37,124 children aged 6 - 14 were examined for a DMF figure - the 6 year-olds had a DMF of 0.53 and the 14 year-olds had a DMF of 2.51. The comparative DMF figures for Nauru were 6 year-olds 0.6 and 14 year-olds 5.0. It would only be an assumption that the higher figure for 14 year-olds in Nauru would be accounted for by Nauru having no rural-type population who are not exposed to refined carbohydrates. Methods were not presented and for this reason lengthy discussion cannot be entertained.

Russell, Leatherwood, Hein and Van Reen (1965[44]) examined 3,714 persons from South Vietnam for dental caries. The adult DMF score was presented in age groups that conflicted with those recommended by WHO Technical Report Series No.

242 (1962[55]). The DMF was also presented in two different forms:

a. excluding filled teeth and teeth crowned for decorative purposes;

b. including filled teeth crowned for decorative purposes.

The children were examined in yearly groups from 1 to 14 and dmf and DMF scores were presented. Along with this dental caries team came specialists, physicians, nutritionists, food technologists, biochemists and nurses. The general health and diet was observed by the latter group. The Nauruan DMF values were slightly higher than those from South Vietnam. Having assessed the caries-diet relationship these workers concluded "caries experience in the permanent teeth of these people was low by whatever method of estimation, often at least two millenia of adherence to a traditional diet based mainly on polished rice, soft in consistency, principally carbohydrate, and perilously low in Vitamin A, thiamine and riboflavin".

In their summary of this survey the following emerged: "No true relation between nutrition and caries could be demonstrated".

Russell, Leatherwood, Consolazio and Van Reen (1965[45]) examined 2,744 persons in South Vietnam for periodontal scores. The method of scoring periodontal disease was that of Russell (1956[41]); the Periodontal Index (PI), one recommended by an expert Committee in the WHO Technical Report Series No. 207 (1961[54]). Oral hygiene was scored by the modified system of Greene & Vermillion (1960[20] and 1964[21]) and presented as OHI-S. As with the dental caries survey in South Vietnam, the health and diet were simultaneously examined by experts in these fields. A "strong association between age or oral hygiene and periodontal condition, in this population, cannot be obscured

by whatever method of analysis".

Age groups from 15 to 44 in this survey correspond to those of the Nauru thesis survey. From 45 years of age and upwards the groups are different. The South Vietnam survey was far more extensive than that of Nauru and the workers did observe a great variation in the PI scores when locality was considered. South Vietnam was able to provide both mountain and coastal dwellers. They observed a generally higher PI in the villages with lower intakes of calories, protein, carbohydrate, riboflavin and iron. However "no strong association between any specific nutrient and disease could be demonstrated when the effects of age and hygiene were considered simultaneously".

Russell (1963[42]) presented a summary of dental caries and periodontal disease surveys in Alaska, Ethiopa, Equador, South Vietnam, Chile, Colombia, Thailand and Lebanon. 21,559 persons were included from these eight areas. PI, OHI and DMF indices were used and the age groups were 5 - 9, 10 - 14, 15 - 19, 20 - 29, 30 - 39, 40 - 49 and 50 years and over. The findings from these studies "support previous conclusions by other investigators that the freedom from dental caries commonly observed in primitive peoples cannot be ascribed to any superiority in nutrition". PI and OHI (& OHI-S) scores were intimately related in all the countries examined. The Nauru thesis survey paralleled this. Russell found that high PI scores were found with groups that tended to be deficient in Vitamin A.

Taylor (1966[49]) examined 236 people from Easter Island aged 18 years or older. A DMF was taken of 28 teeth (third

molars were excluded) and "bitewing radiographs were taken where indicated".

Age groups to present DMF were 10 - 19, 20 - 29, through to 70 - 79. Oral hygiene was listed as a percentage being either good, fair and poor. Calculus also was listed as a percentage being heavy, moderate or light.

Of the 310 people 20 years and older 211 were examined. The DMF for 20 - 29 group was 17.23. This would compare with a DMF of 7.6 from a comparable group on Nauru. The use of radiographs and deletion of third molars would not account for such a divergent result.

Taylor concludes poor oral hygiene was responsible for the very high rate of dental caries.

Barmes (1968[2 & 3]) presented a caries survey of New Guinea and related it to 6 dietary groups: Age groups for adequate comparison were not presented. Caries measurement was presented for deciduous (dmf) and permanent (DMF) teeth and percentage of persons with caries was presented. The ages were recorded as follows: "0 - 1: infants; 1 - 5: 12 or more deciduous teeth; 6 - 10: 1 or more permanent molars; 11 - 15: 1 or more 2nd permanent molars; 16 - 29: 1 or more 3rd permanent molars; 30 - 44: middle-aged adults; 45 & over: aged, where records were inadequate."

A sample of his caries measurements indicates the wide variations he found between different dietary groups:

Group	1	-	1.93	DMF	teeth	per	100	teeth
"	2	-	5.29	"	"	"	"	"
"	3	-	24.78	"	"	"	"	"
"	4	-	8.38	"	"	"	"	"
"	5	-	26.26	"	"	"	"	"
"	6	-	0.06	"	"	"	"	"

Brands (1968[7]) while reviewing surveys of New Guinea observed a wide variation in groups with dental caries prevalence. He also noted that adequate comparisons are hindered by the use of different indices, lack of age distributions and separate consideration of the two dentitions.

Barmes (1969[4]) while observing dental caries in the Sepik area of New Guinea used age groups 4 - 8, 16 - 25 and 40 - 45. (No reason was given for omitting 8 - 16 and 25 - 40 age groups.) Oral debris was observed and it was noted "significant and highly significant correlation between caries measurements.....and oral debris per person in both dentitions".

Dental caries was recorded as DMFT/100 teeth and oral debris by the Green & Vermillion OHI-S scoring method.

MATERIAL AND METHODS

1. Description of Nauru

Most people seeing Nauru for the first time do so from a ship's rail and their impression is usually confined to its apparent smallness (5,263 acres) and its rich lush tropical foliage. Nauru is situated in the Central Pacific in latitude 0 degrees and 32 minutes South and Longitude 116 degrees 55 minutes East (the Territory of Nauru - Annual Report 1964-65 (1965[50])). See Figs. 1, 2 and 3.

The island is completely surrounded by a coral reef and does not possess a natural harbour. A channel has been blasted through the reef to the edge of the island where a small artificial harbour is used by flat bottom power barges some 30 feet in length.

There are 3,658 acres classified as phosphate land and by 1964, 1,364 acres had been mined to yield approximately 35 million tons of phosphate.*

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* Robson (1956[40]) observes the fine quality of Nauru phosphate and says "the value of its phosphate rock is almost beyond computation."

Figure 1

A typical Nauran home surrounded by coconut palms and frangipanni trees. Electricity is supplied throughout the island and in some homes the telephone is connected.

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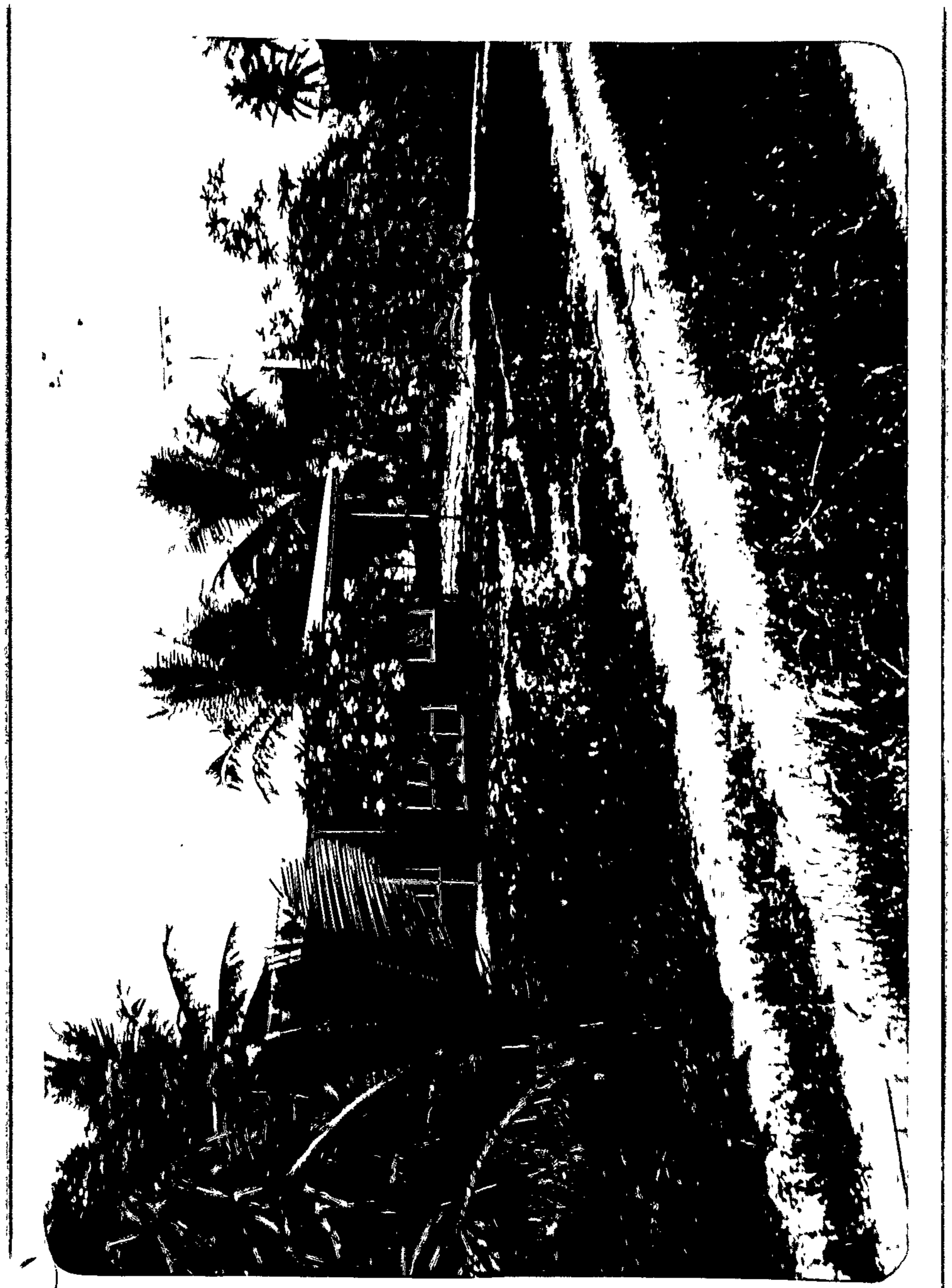


Figure 2

Approaching Anibare Bay

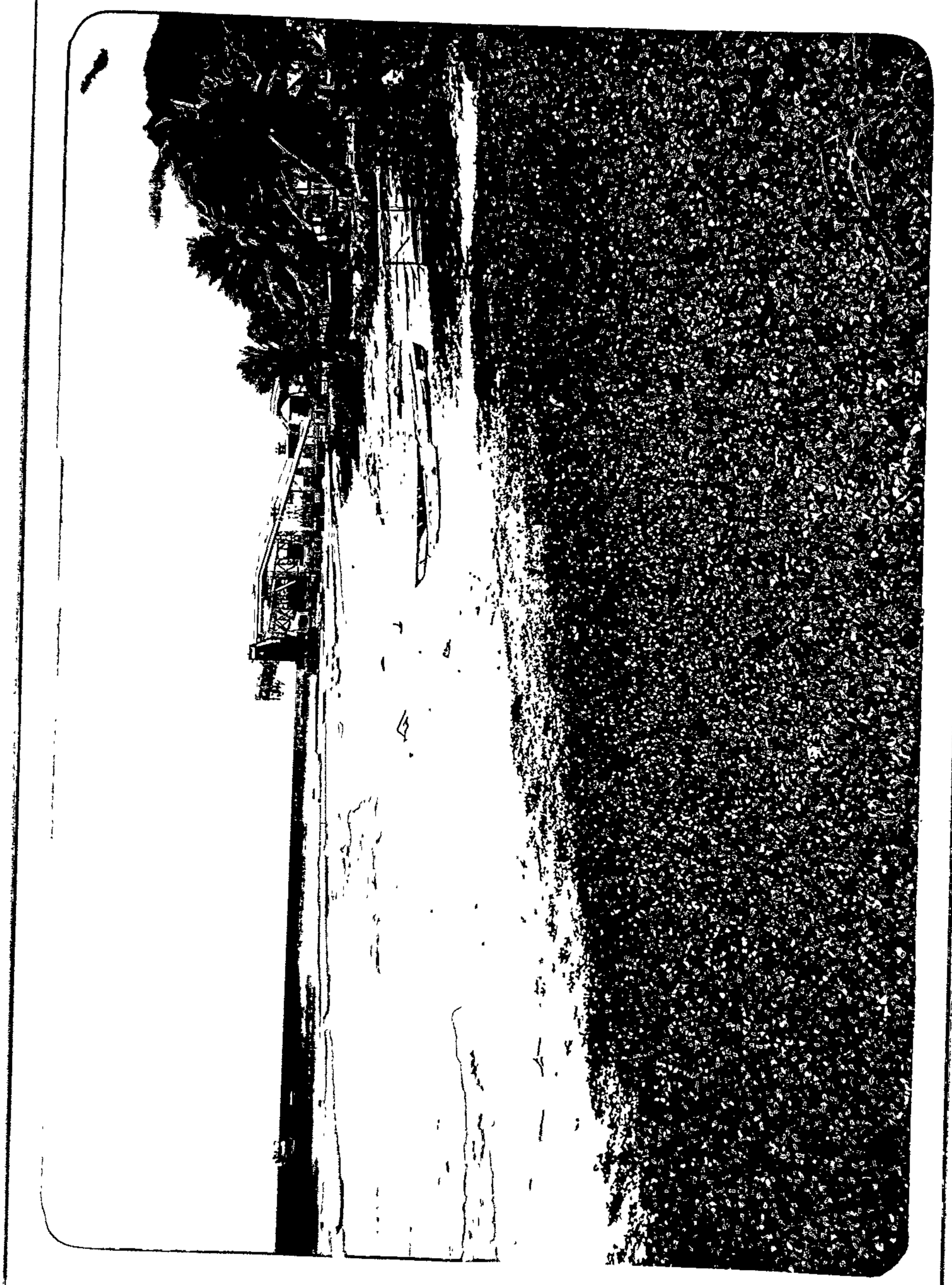
This is on the "remote" side of the island. The tar sealed road in the foreground encircles the island. In periods of dry weather the luxuriant growth, displayed on the right and left of the photograph, dies off to expose coral pinnacles.

Figure 3

Scene from the "developed" side of the island.

In the centre, background, is one of the cantilevers used to load phosphate on to the ships. To the left can be seen the mooring buoys and a small inter-island vessel from the Marshall Islands in the North.

Aluminium boats and a four man fishing canoe are on the beach. Being sheltered from the prevailing easterly winds, this is the section of the island that was most inhabited when discovered by Fearn in 1798.



Assuming that there are still two-thirds of the phosphate yet to be recovered and the current price of $14 a ton is paid to the Nauruans, it can be quickly calculated that the 3,000 odd Nauruans might be reasonably allowed to expect a total payment of $980,000,000 or,in round figures, one billion dollars when the phosphate expires. The wealth potential evident in figure 4 has a profound effect on the Nauruans' attitude to the present and future. The climate is tropical and usually a westerly season (bad weather for loading and fishing) of three/four months, and an easterly season are to be found. An average annual rainfall of 80" is low for a Pacific Island and yearly variations of from 12 to 180 inches have been recorded, so it can be seen that there is not a regular weather pattern. For the year 1964-65 the mean minimum temperature 75.1^{o} was recorded in April '65 and the mean maximum of 87.8^{o} was recorded in December '64. From these brief figures it can be understood that long periods spent under these conditions have an adverse effect on the majority of Europeans (Caucasians) who live there and it also demonstrates the remarkable way the Nauruans have adapted themselves to these severe climatic conditions. (This adaptation by the Pacific Islander was stressed by the Resident Commissioner of the Gilbert and Ellice Island Colony in his opening address at the S.P.C. Seminar on Health Problems of Coral Atoll Populations, Tarawa, Gilbert Islands, May 1967).

On viewing a map of the Pacific it will be seen that Nauru is placed between two chains of islands - the Solomons to the South and the Marshall, Gilbert and Ellice groups to the North. When man moved from Asia down to the Pacific he followed these two routes apparently by-passing Nauru.

There appears no early history of Nauru and their early lineage is reputedly mixed Polynesian, Micronesian and Melanesian.

This isolation led the Nauruans to shun strangers with the result that most people who strayed to their shores were killed on arrival. I feel caution must be exercised when interpreting any statements that depend largely on "folk lore" and traditional evening story telling sessions conducted by the adults for the benefit of the younger ones. +

+ Wedgwood (1936[52]) after a stay of four months on Nauru wrote "I did not find it possible to enter into the life of the Nauruans as formerly I had entered into the life of my native friends in New Guinea."

Figure 4

Photograph taken from the highest point on Nauru in the heart of the phosphate deposits.
Foreground shows practically pure phosphate. To the left in centre field is cleared land ready for the removal ("lifting") of phosphate.
To the right is uncleared land. The Pacific Ocean is in the background.

In 1798 Captain John Fearn discovered Nauru: since then whalers and traders have visited the shores for the singularly attractive girls whose natural beauty surpasses that of surrounding islands.* Hence the family names of Harris, Stephens and Scotty, to mention a few, appeared in the tribes and eventually council records.

So now we have a further confusion as to the genetic structure of these people as these same whalers and traders were of German, Negro, English, Scottish, Japanese and Chinese extraction. See Figs. 5, 6, 7.

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* In 1844 Simpson[47] observed "The men are about the middle size, well, but not robustly made, of a dark copper colour, with a very smooth sleek skin; they had no beard, hair black and straight; they have no affinity to the Papuan race, but are evidently, from their high cheek bones and irregular cast of features, of the Malayan descent; and from what I saw of the natives of the island of Ascension, one of the Carolines, North Pacific, I am of the opinion they are both sprung from the same origin.....

"These natives, unlike their prototypes on the Island of Ascension in this respect, have no tradition of their origin, or the manner their forefathers came to the island: they have no religion of any kind, neither do they believe in a future state; they appear, however, to have some slight idea of an evil spirit.

"They are divided into several tribes, each tribe governed by a chief and queen, who presides over the whole; it is her duty to decide all disputes which may arise among the chiefs, and from her decision there is no appeal; in her also is vested the sovereign prerogative of making peace or war among the different tribes; and on all these occasions I am told she is implicitly obeyed.

"From what I could learn there were about 1,400 inhabitants on the island, which is only fourteen miles in circumference....."

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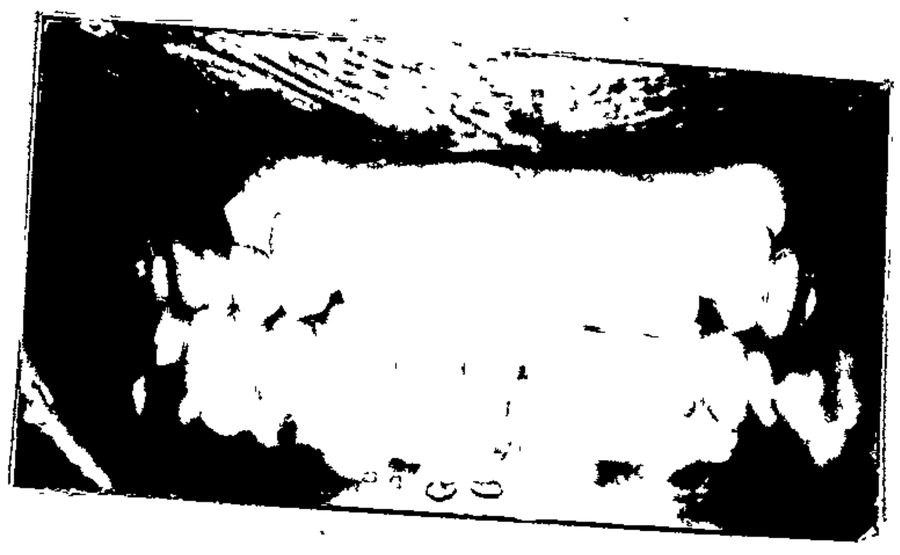
Figure 5

Nauruan, Female.

Aged 20 years

PI = 0.2, OHI-S = 0, DMF = 3.

Figure 6



Nauruan, Female.

Aged 27 years

PI = 0.8, OHI-S = 1.6, DMF = 1.

Figure 7

Nauruan, Male.

Aged 78 years

PI = 6.7, OHI-S = 5.7, DMF = 26.

The Nauruan of to-day is healthy and intelligent, and Long (1966[34]) states "the occular health of Nauruans is excellent". Wedgwood (1936[52]) on discussing the Nauruan features had this to say, "to anyone accustomed to peoples of New Guinea, the Nauruans present a magnificent spectacle of physical fitness and strength. According to my informants, sickness was scarcely known before the arrival of the white man, though prior to this the Gilbertese had introduced some death and sickness magic into the island." She further quoted Hambruck, the German expedition leader, who observed a death rate of 33 and a birthrate of 23 around a period of 1908 and 1910. Through the decades various diseases have been introduced to the island (Audi (1967[1]) lists beri beri, leprosy, helminthiasis and protozoal intestinal parasites). The island's health department has efficiently controlled these conditions.

With German, Japanese and British (mainly Australian) doctrine for the past 50 years being forced upon a shy, kind and self sufficient community, it is full credit to these people they have evolved to their present status and to be accepted on European terms. As Hogbin and Wedgwood (1943[23]) express similar sentiments on the development and welfare in the Western Pacific, "failure to appreciate the relationship of aboriginal peoples to the land they occupy has everywhere proved a fruitful source of dissatisfaction with European rule."

2. Materials Used

The dental clinic in use at the time of the survey consisted of two dental chairs in one room, an office and a laboratory. Staff consisted of 1 Dental Technician (also interpreter), 1 Assistant Dental Technician and 2 Dental Nurses. See Figs. 8 and 9.

It was elected to do all examinations in a chair which, even though it faced a wall, possessed a compressed air attachment and a unit mounted operating light. Busch plane mirrors No. 5 and sickle probes Ash No. 54 were used. Due to delays in fulfilling orders only 6 dozen mirrors and probes were used for the entire survey. All instruments were sterilised in boiling water, with Antirust powder added, for a minimum of 10 minutes (as indicated by Smith's timer). The mirrors stood up well but the probes required sharpening by hand. This was done weekly. With a long adaptor (similar to that found on a hand chip blower) a compressed air system was used to dry the teeth and where possible reflect back the free gingivae. Ceiling mounted lights and a unit mounted Sterling operating light were used for all examinations. Also present was very good natural lighting as both ends of the surgery were completely filled with windows.

Figure 8

Dental Technician Billiam Angwilby outside his home.

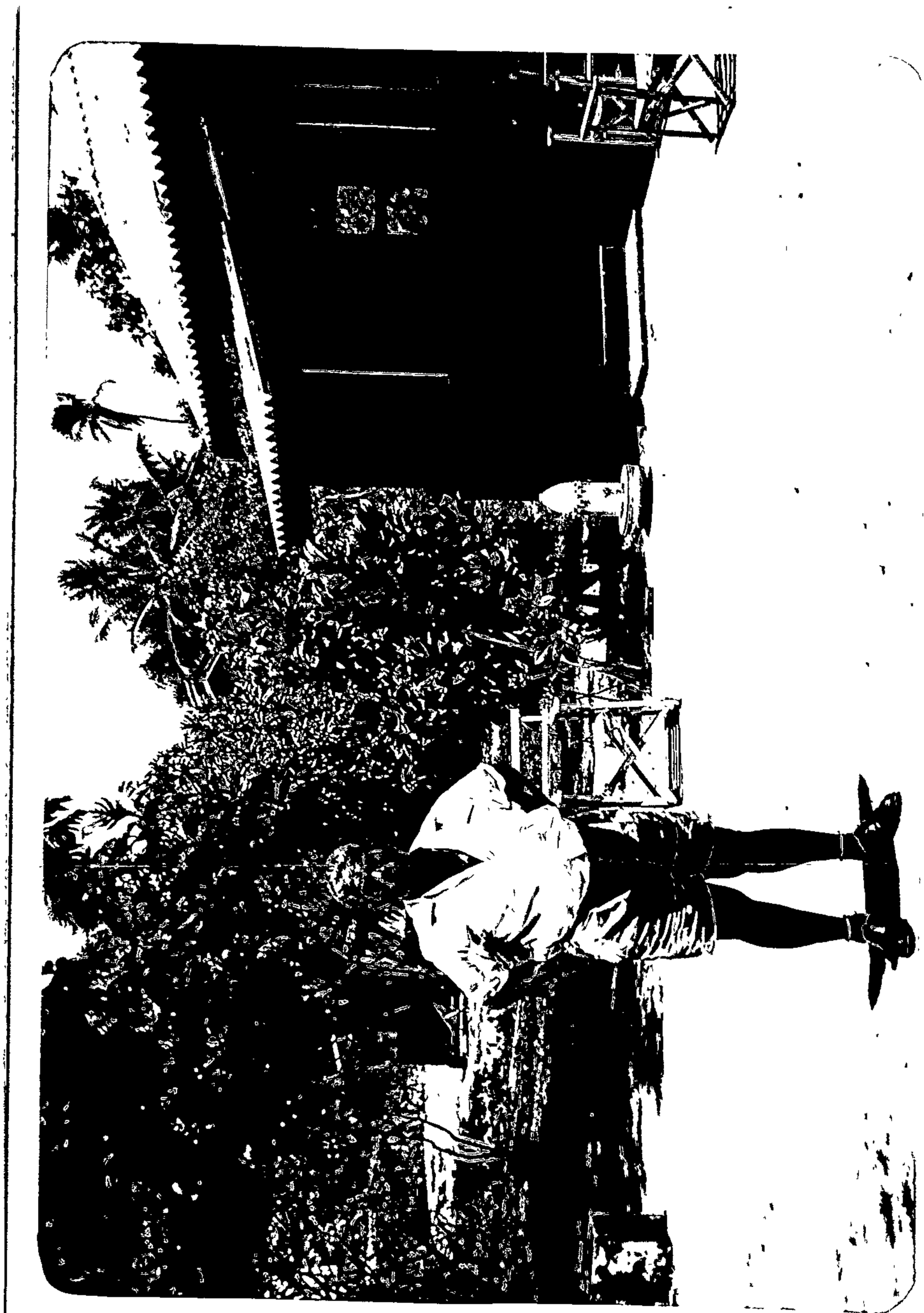


Figure 9

View from the Dental Clinic.

This photograph was taken looking towards the centre of the island.

The trees in the background represent the beginning of the rich phosphate bearing land that seldom rises above the height seen here.

3. Design of Chart

The chart designed is shown in Figure 10. Reasons for this format are listed below.

(1) Only one side was used to save time in turning over, thus enabling any fact to be obtained at a glance.

(2) The chart size was small enough for a compact filing cabinet.

(3) As there was a doubt as to using these charts for future surveys, all available area could be used and maximum personal data recorded because of the name changing habits that still persist e.g. DEMAUNGA WITAM - WITAM is the father's name, but when father dies the child (like the Australian Aborigine) refused to mention or recognise the name WITAM.

(4) In the hope that they may be of future value, these charts have been preserved and the present resident district was inserted in brackets after the subject's names as a further aid for possible later identification.

(5) In accordance with WHO; Age, Race and Sex were also included.

(6) The method of performing PI, DMF and df and OHI-S counts in that order was arrived at because the examiner found it harder to elicit gingival colour and contour if the tissues were traumatised and bleeding while inspecting for caries or debris/calculus.

Even though bleeding could occur after the PI examination, the use of an air blast or gauze squares gave adequate vision to complete the examination.

The debris, stain and calculus were in the majority of cases difficult to remove and so their image was not unduly

Figure 10

NAME District AGE RACE SEX

R. 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L.

PI = Total Score / No. of Teeth = ____

Date of examination

No. of teeth present, Primary =
Permanent =

No. of teeth	Primary	Permanent
Decayed		
Missing		
Filled		
Total	df	DMF

DI-S (debris)			CI-S (calculus)		
U.R. buc.	U.R. lab.	U.L. buc.	U.R. buc.	U.R. lab.	U.L. buc.
L.R. ling.	L.L. lab.	L.L. ling.	L.R. ling.	L.L. lab.	L.L. ling.

Total DI-S / No. of teeth = ____

Total CI-S / No. of teeth = ____

OHI-S = DI-S + CI-S = + =

altered by the preceding examinations.

The number of primary and permanent teeth present were counted at the time of examination.

A gestetner stencil was prepared by Edwin Tsitsi and charts were run off on the Nauru General Hospital's duplicator.

4. Population Examined

The total population of Nauru from the 1965 census was 5,561 persons (Territory of Nauru, Report 1964-1965, p.57[50]).

The Nauruan population was 2,734 persons of which 696 were 0 - 4 years of age. The eventual figure of persons eligible for examination under the proposed Dental Health Report Form, WHO Technical Report Series No. 242[(55)] was 2,038. The number of persons examined from five years and over was 1,420 which was 70 per cent of those eligible.

Due to well defined living areas on the island it was not difficult to exclude from the examination the 446 Europeans, 900 Chinese and 1,481 Other Pacific Islanders.

5. Problems Encountered

1. It was first hoped that during the examination a few verbal questions might be of additional value to the survey e.g. (1) do you eat raw fish daily; (2) do you eat coconut - (young and/or old) daily; (3) do you brush your teeth and how often? Questions (1) and (2) were easy enough to translate into the Nauruan language but question (3) fairly impossible. To commence with, there is no Nauruan word for "teeth" nor is there a word for "brush".

As Wedgwood (1936[52]) and Cadell (1958[9]) have mentioned: even if the question was understood, the reply would be moulded by the subject to please the examiner. Secondly on the Eastern side of the island where the so-called "country people" lived, the people were very shy and reserved and more often than not the question would be met with silence, sometimes a stare, sometimes a lowered head and sometimes a nervous giggle.

No doubt if time was not at a premium, 5 or 6 years would eventually see a fairly truthful picture emerging as by this time the examiner would have a better grasp of the Nauruan language and its different dialects and would also share a greater part of their confidence.

2. Failure to attend the clinic for examination because of shyness or modesty was also a factor that greatly affected some people. Here I feel these people did not refrain from coming because of an imagined dental abnormality. I feel it was purely this traditional island isolation of centuries manifesting itself.

3. Prolonged stays in tropical climates affect Europeans (Caucasians) differently. Most Europeans need a break from the

heat and humidity and a rest in a cooler climate - if this is not obtained their general physical and mental condition gradually deteriorates. As a result, examination of larger numbers daily was a physical impossibility and see this survey covered six months. If the examiner was able to perform only examinations and was not solely responsible for all the island's dental care at the same time, then this time could obviously be shortened.

4. The older age groups are notoriously vague about their exact age - I have confirmed this with Tihàla Malaki, the only dentist in the Gilbert Islands, who informs me that this vagueness about age is also common in both Gilbert and Ellice Island groups. So this must be borne in mind when interpreting the older age group results. Williams (1939[53]) experienced a similar problem in Samoa.

5. Not only are names changed but they are at times added to and others subtracted from: e.g. Orro Stephens adopted the name Lawrence and dropped the name Orro. Whilst his Nauruan friends occasionally call him Orro, there are very few Europeans who would attract his attention by calling him Orro. In other words, Lawrence Stephens feels more at ease being called Lawrence by a European and so feels entitled not to respond to a European examiner if called Orro Stephens.

6. The isolation from other dentists becomes acute and dental text-books and dental journals do not suffice to answer the odd question when doubt arises - reference books of course help to alleviate major doubts but sometimes a lingering doubt remains. For example, on first arrival, the impression of the children's DMF scores was that the Nauruan children's teeth were affected to a similar degree as Australian children's teeth (Halikis 1962[22]). The survey disproved this. However, I did

not attempt to examine for orthodontic anomalies because

(a) I felt there were few anomalies present, and

(b) I did not feel entirely competent to make these classifications. Perhaps a second dentist to discuss this problem would have seen this fact included in the examination.

6. Standardisation

During the first six months random patients were examined in an attempt to (1) standardise our time spent on each patient: (2) learn a few basic Nauruan terms, e.g. "kay babo" - rinse out; "bwaida mim" - open your mouth; "ouwak" - wide; "metu kor" - come in please; "megeda kor" - sit down please; "mugga edegene" - where is the pain: (3) acquaint the recorder and examiner with the chart and speed of relaying the findings from the mouth to the chart: (4) to assess "normal" gingiva in the Nauruan mouth and the onset of caries. In Australia several clinical sessions were held with Mr. S. Levine in an effort to standardise the eventual assessment of "normal" gingiva and the conditions listed as "gingivitis" and "periodontitis", by Grant, Stern and Everett (1963[18]). In relation to the "normal gingiva" problem, the author was very fortunate to have the assistance of Mr. Ludwig Keke, Nauru's first dental graduate, a B.D.Sc. from Queensland University. Together, on Nauru, we studied Grant, Stern and Everett (1963[18]) (See p.38) and then made suitable alterations for the group to be studied.

"1. Color: The color of 'normal' gingiva is pale pink." This was not a common occurrence in Nauruan mouths, pigmentation being common and a colour magenta or blue-red was found to be more applicable.

"2. Papillary contour: Papillae should be pointed and fill the interproximal spaces..." This condition was common in the groups under 20 years of age but in adults "A blunter contour must also be considered normal."

"3. Marginal contour: The gingiva should slope coronally to end in a thin edge" - as with the papillary contour, it was found a macroscopic rounding the marginal gingiva in adults.

"4. Texture: Stippling is generally present to a varying degree" - stippling was practically universal and prominent on attached gingiva.

"5. Consistency: Gingiva should be firm, and the attached part should be firmly enclosed to the teeth and underlying alveolar bone." This was acceptable for the purposes of the survey.

"6. Pockets: ... there should be no pockets." As in 5. this was accepted without alteration.

"7. Exudate: there should be no exudate." As in 5.

(5) Experiment at recording pocket depth with a Periodontal probe (with 4 and 6 mm. markings omitted) was discontinued; because of the heavy debris and calculus encountered it was found difficult to record accurately the precise free marginal level: it was impractical from a time position to perform the prior scaling and prophyloxis before measuring and recording.

(6) where a tooth was examined and it possessed deep occlusal fissures in the case of molars and bicuspids, and lingual fissures in the case of upper anteriors, there was often evident a brown to black stain and in this a probe would occasionally catch. Now if seen in a mouth on a patient in Sydney, I would not hesitate to call this caries - as had the Dental Officer before me (Mr. W. Gadd). As chance would fall our way, we did manage to find some of his examination charts and unequivocally compare these patients with his interpretation of a carious lesion with that of ours. There were several cases where these surfaces had been

marked down by Gadd 2 years previously as being carious. Yet when examined by the author and Keke and eventually mechanically exposed with the air-rotor drill, that, in effect there was no visible sign of dental caries. So our ultimate decision for this type of caries was (a) run the probe along the fissure and scrape away this brown-black material: (b) only if the probe could be inserted into a defect to an estimate 0.5 mm. and so devise a "catch" when moved in any direction (apart from that of withdrawal) then we classified this as dental caries present. Caries in other areas presented no problems.

In Australia 10 patients with an average DMF teeth per person of 15.8 were examined by the author and Mr. P. Barnard. The author's examination results were $\pm$ 3% from those of P. Barnard and within the standard for examiners of the Department of Preventive Dentistry, Sydney University.

(7) When fresh x-ray film could be obtained, and when the condition in the x-ray department permitted, routine bitewing examinations were performed on random patients. These x-rays showed remarkably little interproximal caries and, as the patients increased in age, the interproximal alveolar bone resorbed horizontally. As mentioned, standardised x-ray techniques in the dental clinic were not possible at this stage. Without air-conditioning the Kodak DF.11 film was often developed in 30 seconds and fixed in 2 minutes. Some attempt was made to store x-ray film in a household sized refrigerator but developer and fixer were stored at room temperature. In 1966 a Commonwealth Radiologist was sent to Nauru to examine and advise on the Radiology Department. His report briefly expressed amazement that x-rays could be taken under existing conditions and that a completely

air-conditioned block would be essential in the future.

(8) With the aid of plaque disclosing tablets we experimented with observing and recording plaque (see Fig. 11). This was time consuming as the children had to be closely observed to ensure the tablet was not swallowed prematurely. It did, however, draw to our attention the error of relying on colour to detect plaque and that great care must be taken when running the side of the probe along the tooth and that a flat positive contact was made. As a result of this it became apparent that the thinner portion of the probe was more accurate in detecting plaque and so two or three traverses were made across the tooth commencing from the occlusal (incisal) surface. This would lead to overscoring if compared with an examiner who made one traverse across the tooth.

With the knowledge learnt in this six months the examination methods were performed to the directions of the WHO Technical Report Series No. 207 (1961[54]) and No. 242 (1962[55]).

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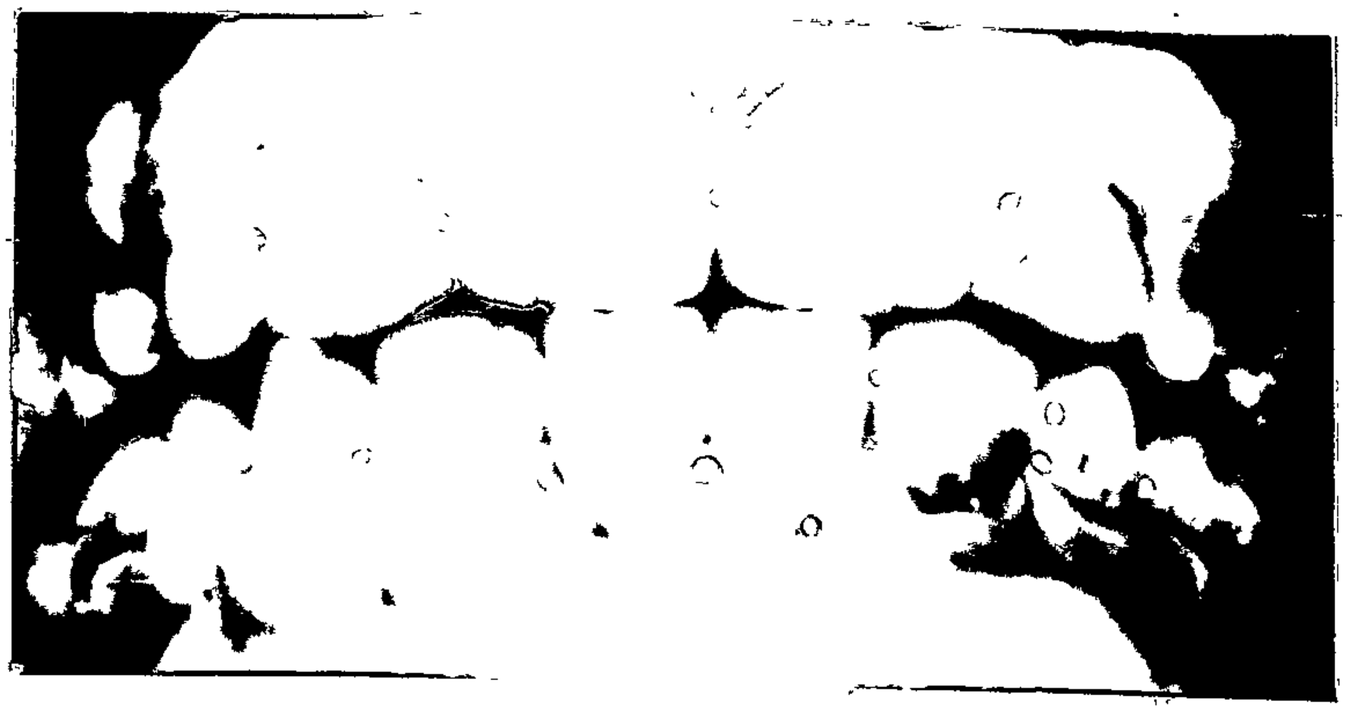
Figure 11

Nauruan aged 10 years before chewing plaque disclosing tablet.



Same patient after chewing plaque disclosing tablet.

7. Indices Used

It was resolved to follow the WHO Technical Report Series Nos. 207[54] and 242[55] for index selection.

Dental caries was evaluated after the method presented by Klein and Palmer (1941[33]) where the decayed, missing and filled (DMF) permanent teeth were recorded. This index and df teeth (decayed and filled deciduous teeth) index were recommended by WHO T.R. Series No. 242 (1962[55]).

Periodontal disease evaluation embraced the Periodontal Index (PI) of Russell (1956[41]) as prescribed by the WHO Technical Report Series No. 207[54].

Oral hygiene evaluation was the simplified oral hygiene index (OHI-S) of Greene and Vermillion (1964[21]) which is a modification of the index recommended in WHO Technical Report Series 207[54].

The presence or absence of gingivitis was recorded for all individuals. Similar to Russell's (1956[41]) PI scoring system, where in doubt about inflammation being present, gingivitis was recorded as absent.

The percentage of persons caries free was calculated for comparison with earlier surveys.

Prosthetic requirements were observed only where a complete arch was edentulous.

Handicapping dentofacial anomalies were not recorded.

8. Examination Method

All subjects of school age were collected from the schools in groups of 9 for the primary school and 6 for the secondary school. Examination times for all school children were arranged to the convenience of the teachers concerned - most examinations in these groups were carried out in the afternoon. All other subjects were given a printed form requesting them to be present at the surgery at a time set by the examiner - usually 8.00 a.m. or 2.00 p.m. The adults presented in order regardless of age. Transport was supplied to people who required same. This second group was selected from the T.B. Clinic's files - possibly the most comprehensive list of the island's numbers, age, sex and present house of abode.

This onerous task was performed expertly by the Medical Orderly Akibwib - I might mention here that Akibwib would choose the most suitable nights to present these forms, and by personal exhortation was responsible for the very good attendance at the clinic. As Cadell[9] mentions "in fifty years there have been three administrations each with a different language: German, British and Japanese." and "Although the English language has been readily accepted, Nauruans still use the native language, and some older people, even if able, refuse to speak English." These two quotes adequately explain the problems of attracting people to a dental clinic to be examined. Yet Bedkober (1936[5]) reported no troubles in examining the entire island population.

Weather and general climatic conditions during the 6 month period of examination were normal. All examinations were

performed by the author. The examiner stood for all examinations and the recorder also stood in a position to the side of the examiner and 2 feet away - this enabled the examiner to keep a check on notations that were made by the recorder and it also meant the recorder had little difficulty hearing the examiner's instructions.

Nurses Beniana, Yolanda and Etunia were tried as recorders but their shyness did not lend itself to accuracy and so Nicodemus, our trainee dental technician, was the recorder used for the survey.

At the end of each examination session the data from the examination charts was transferred to the respective age groups. Results for the age groups were not computed until the survey was completed. This prevented the examiner from forming premature conclusions.

These figures were then transferred to a Dental Health Survey Report Form (see Figs. 12 and 13). It will be readily ascertained that these two summary sheets resemble very closely that recommended by the WHO Technical Report Series 242 (1962[55]) page 23.

9. Analysis of Data

Fig. 13 presents mean index figures, by age groups, for the indices OHI-S, PI and DMF. Standard Errors (SE) and Standard Deviations (SD) of these means were also calculated and are given in Table 1.

Further calculations were performed for the coefficient of correlation between PI and DI-S, PI and CI-S and PI and OHI-S and for the statistical significance of the coefficient of correlation. All statistical calculations were performed under the guidance of Mr. Peter Barnard of the Department of Preventive Dentistry, University of Sydney on the Department's electronic calculating machine.

Dental caries was presented as total decayed teeth and average decayed teeth per person, total missing teeth and average missing teeth per person, total filled teeth and average filled teeth per person, average decayed, missing and filled teeth per person and the percentage of persons caries free.

Periodontal disease was presented as the average PI score per person, and the average Debris Index per person, the average Calculus Index per person as well as the average Oral Hygiene Index per person were calculated.

TABLE 1

ANALYSIS OF DATA

AGE GROUP *	AVERAGE OHI-S	AVERAGE PI	AVERAGE DMF
$12_{(61)}$	3.2 SD^{+}_{-} 1.1	1.2 SD^{+}_{-} 0.7	3.2 SD^{+}_{-} 3.6
	SE^{+}_{-} 0.1	SE^{+}_{-} 0.1	SE^{+}_{-} 0.5
$13_{(73)}$	3.4 SD^{+}_{-} 1.2	1.3 SD^{+}_{-} 0.6	3.9 SD^{+}_{-} 3.1
	SE^{+}_{-} 0.1	SE^{+}_{-} 0.1	SE^{+}_{-} 0.4
$14_{(58)}$	3.2 SD^{+}_{-} 1.2	1.4 SD^{+}_{-} 0.5	5.0 SD^{+}_{-} 3.3
	SE^{+}_{-} 0.2	SE^{+}_{-} 0.1	SE^{+}_{-} 0.4
15-19 (140)	3.0 SD^{+}_{-} 1.4	1.7 SD^{+}_{-} 1.0	4.9 SD^{+}_{-} 4.1
	SE^{+}_{-} 0.1	SE^{+}_{-} 0.1	SE^{+}_{-} 0.3
20-24 (55)	2.6 SD^{+}_{-} 1.5	2.3 SD^{+}_{-} 1.6	7.9 SD^{+}_{-} 5.2
	SE^{+}_{-} 0.2	SE^{+}_{-} 0.2	SE^{+}_{-} 0.7
25-29 (54)	3.4 SD^{+}_{-} 1.5	3.5 SD^{+}_{-} 1.7	7.3 SD^{+}_{-} 7.0
	SE^{+}_{-} 0.2	SE^{+}_{-} 0.2	SE^{+}_{-} 1.0
30-34 (50)	3.8 SD^{+}_{-} 1.4	4.5 SD^{+}_{-} 1.7	8.2 SD^{+}_{-} 6.5
	SE^{+}_{-} 0.2	SE^{+}_{-} 0.2	SE^{+}_{-} 0.9
35-44 (99)	4.2 SD^{+}_{-} 1.2	5.0 SD^{+}_{-} 1.4	9.9 SD^{+}_{-} 7.4
	SE^{+}_{-} 0.1	SE^{+}_{-} 0.1	SE^{+}_{-} 0.7
45-54 (81)	4.5 SD^{+}_{-} 1.1	5.5 SD^{+}_{-} 1.2	12.0 SD^{+}_{-} 7.8
	SE^{+}_{-} 0.1	SE^{+}_{-} 0.1	SE^{+}_{-} 0.9
55-64 (50)	4.7 SD^{+}_{-} 1.2	5.9 SD^{+}_{-} 0.8	15.6 SD^{+}_{-} 9.9
	SE^{+}_{-} 0.2	SE^{+}_{-} 0.1	SE^{+}_{-} 1.4
65-74 (30)	4.5 SD^{+}_{-} 1.2	5.6 SD^{+}_{-} 1.6	19.0 SD^{+}_{-} 11.0
	SE^{+}_{-} 0.3	SE^{+}_{-} 0.3	SE^{+}_{-} 2.0

* Numbers in brackets represent number of persons in each age group.

10. Assessment of Diet

Cadell (1958[9]) (1959[10]) and Bedkober (1938[5]) have attempted to present the Nauruan diet. My impressions of the Nauruan diet were:

1. the children eat a high percentage of sweets, tinned food and general refined carbohydrates;

2. the adults eat a high proportion of rice, raw fish and coconut;

3. some Nauruans would eat entirely "natural" foods and others would eat entirely imported foods.

The decision not to study the Nauruan diet in detail was based on the following:

a. the author was not a trained dietitian;

b. time was at a premium;

c. there was great doubt that verbal questions about diet would be answered accurately, but rather in a manner to please the author;

d. it was not possible to live in the homes to observe the eating habits.

RESULTS

Dental Health Survey Report

The Figures 12 and 13 present in summary the details of the survey conducted on Nauru. This data after statistical analysis is presented in graph form in Figures 14 to 20 and 22 to 24.

Children 5-11 years - General Findings

It will be observed that by age 11 years the number of children with primary teeth had fallen to roughly 50%. However, I feel of more interest, is the presence of only 90 children out of 126 with one or more permanent teeth at the age of six.

Gingival inflammation was high and was noted in 91% the children. However, as mentioned previously, the examination method and recording index may not truly record the state of gingival inflammation.

The df index decreases with age and the DMF index increases with age.

As all children in this section were at school during the time of examination and very few children were either off the island or absent from school, it can be readily observed that there had been an increase in the island's birthrate; the total number of 5 and 6 year-olds examined was 243 while the total number of 10 and 11 year-olds examined was 156.

Children from 12 years and Adults - General Findings

The total number of people examined in these age groups was 754. The age groups 65-74 and 75 and over contained

insufficient numbers and so interpretation of these results will not be included.

It is not until the age of 55 years that the average number of teeth per person falls below 20.

The average D teeth per person slowly increases with age, the average M teeth per person increases sharply with age after the 35-44 year age groups. The average F teeth per person is confusing as the presence of complete dental treatment has fluctuated throughout the years and so exposing different age groups to different levels of dental treatment.

The DMF index increases with age and the percentage of persons caries free decreases with age, terminating at the 55-64 age group.

The PI index increases uniformly with age.

The DI-S index remains constant throughout the age increase.

The CI-S index and the OHI-S index increase slowly with age.

The first edentulous jaw is not encountered until the age group 30-34 years is reached, where 3 are recorded. The number of edentulous jaws increases with age.

It was found that there was a high correlation indicating a very strong relationship between periodontal disease and calculus as measured by PI and CI-S. The coefficient of correlation (r) was +0.98 and was significant ($P<0.001$).

The relationship between periodontal disease and oral hygiene as measured by PI and OHI-S was also very strong with a coefficient of correlation of +0.90 ($P<0.01$) obtained.

DENTAL HEALTH SURVEY REPORT. FORM 1

COUNTRY - NAURU ISLAND, CENTRAL PACIFIC.

POPULATION OF GROUP EXAMINED - 2,038.

PERIOD OF EXAMINATION; FROM, JULY, 1966
TO DECEMBER, 1966.

EXAMINER - A.J.YULE.

		TOTAL	AGE GROUPS						
			5	6	7	8	9	10	11
Number of persons examined		666	117	126	70	88	107	87	71
Number of persons with primary teeth		616	117	126	70	88	107	72	36
Number of persons with permanent teeth		527	14	90	70	88	107	87	71
Number of persons with gingival inflammation		608	93	111	69	80	101	85	69
DENTAL CARIES	Average number of decayed & filled (df) primary teeth per person	2·9	3·9	3·7	3·9	3·6	3·1	2·0	1·4
	Average number of decayed, missing & filled (DMF) permanent teeth per person	1·4	0·5	0·6	1·2	1·3	1·8	1·7	2·9
	Average df +DMF teeth per person	4·3	4·4	4·3	5·1	4·9	4·9	3·7	4·3

Figure 12

DENTAL HEALTH SURVEY REPORT. FORM 2

		TOTAL	AGE GROUPS 12	13	14	15-19	20-24	25-29	30-34	35-44	45-54	55-64	65-74	75 & over
Number of persons examined		754	61	73	58	140	55	54	50	99	81	50	30	3
Average number of permanent teeth present per person		25·7	27·5	27·8	27·5	28·8	30·2	29·3	28·8	27·2	24·5	19·0	15·7	22·7
DENTAL CARIES	Total decayed (D) teeth	2,180	111	175	97	310	195	191	195	413	310	99	70	14
	Average D teeth per person	2·9	1·8	2·4	1·7	2·2	3·5	3·5	3·9	4·2	3·8	2·0	2·3	4·7
	Total missing (M) teeth	2,734	7	7	29	63	78	137	161	471	611	652	490	28
	Average M teeth per person	3·6	0·1	0·1	0·5	0·4	1·4	2·5	3·2	4·8	7·5	13·0	16·3	9·3
	Total filled (F) teeth	1,143	81	103	166	316	168	67	53	96	54	29	10	0
	Average F teeth per person	1·5	1·3	1·4	2·9	2·3	3·0	1·2	1·1	1·0	0·7	0·6	0·3	0
	Average DMF teeth per person	9·4	3·2	3·9	5·0	4·9	7·9	7·3	8·2	9·9	12·0	15·6	19·0	14·0
	Percentage of persons caries free	9·0%	24·6%	17·8%	8·6%	13·6%	3·6%	11·1%	8·0%	2·0%	2·5%	0	0	0
PERIODONTAL DISEASE	Average Periodontal Index (PI) per person	3·7	1·2	1·3	1·4	1·7	2·3	3·5	4·5	5·0	5·5	5·9	5·6	6·2
	Average Debris Index (DI-S)per person	1·6	1·7	1·7	1·6	1·3	1·0	1·3	1·4	1·7	1·8	2·0	1·9	1·7
	Average Calculus Index (CI-S)per person	2·1	1·5	1·7	1·7	1·7	1·6	2·0	2·3	2·5	2·7	2·7	2·6	2·9
	Average Oral Hygiene Index (OHI-S) per person	3·7	3·2	3·4	3·2	3·0	2·6	3·4	3·8	4·2	4·5	4·7	4·5	4·6
ALL TEETH ABSENT	Upper jaw	28	0	0	0	0	0	0	0	2	6	10	10	0
	Lower jaw	21	0	0	0	0	0	0	0	1	3	8	9	0

Figure 13

The amount of debris (DI-S) showed only a moderate degree of correlation with the PI ($r = +0.48$ and $P < 0.12$).

1. Dental Caries

Results:-

Figure 14 indicates graphically the changes in df and DMF values obtained for the age groups 5 to 11 years. The df index decreases from 3.9 at age 5 to 1.4 at age 11. Conversely the DMF index increases from 0.5 at age 5 to 2.9 at age 11. However when combining df and DMF indices for each age group (see Figure 15 and 22) an overall slight decrease in dental caries prevalence with age is observed. Attention must be drawn to the 5 year-old age group where only 14 persons have permanent teeth. By deleting this score and commencing with the 6 year-old age groups, the df and DMF is 4.3 after six years, increasing to 5.1 at the 7 years age groups and returning to 4.3 at the 11 years age groups.

From Figures 16 and 17 it is readily seen that the DMF index increases with age after 12 years. The increase appears more rapid in the age groups up to 20-24 years than in the following years.

The average D teeth per person increases with age, the average M teeth per person increases with age and the average F teeth per person decreases with age.

Figure 14

Presenting a graph of decayed and filled (df) primary teeth and decayed, missing and filled (DMF) permanent teeth taken from data on Fig. 12.

GRAPH OF df & DMF TEETH

5-11 YEARS

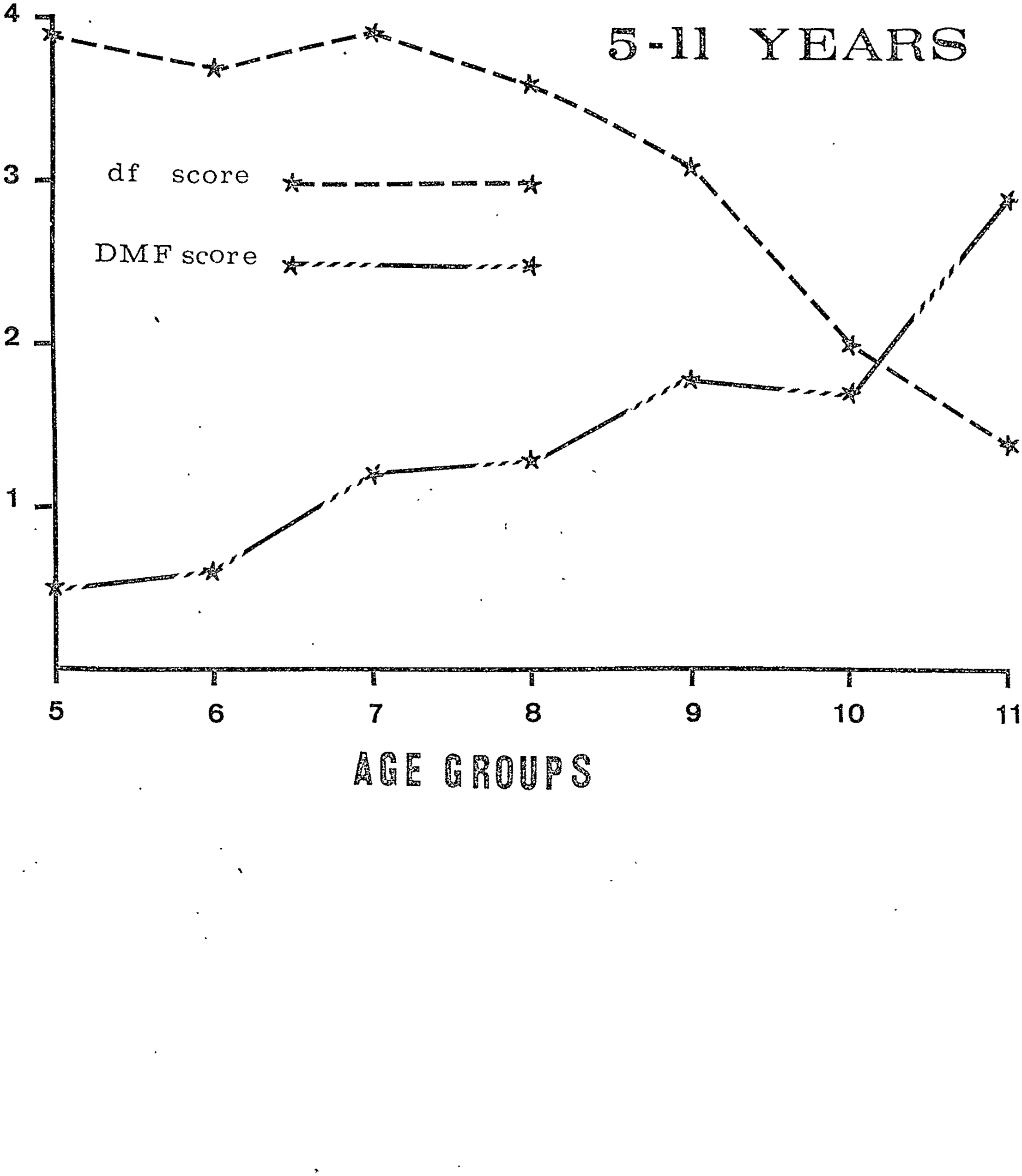


Figure 15

This is a bar graph interpretation of the data presented in Figure 14.

The overall intensity or extent of dental caries remains reasonably uniform between the ages 5 to 11 years inclusive.

df & DMF TEETH

5-11 YEARS

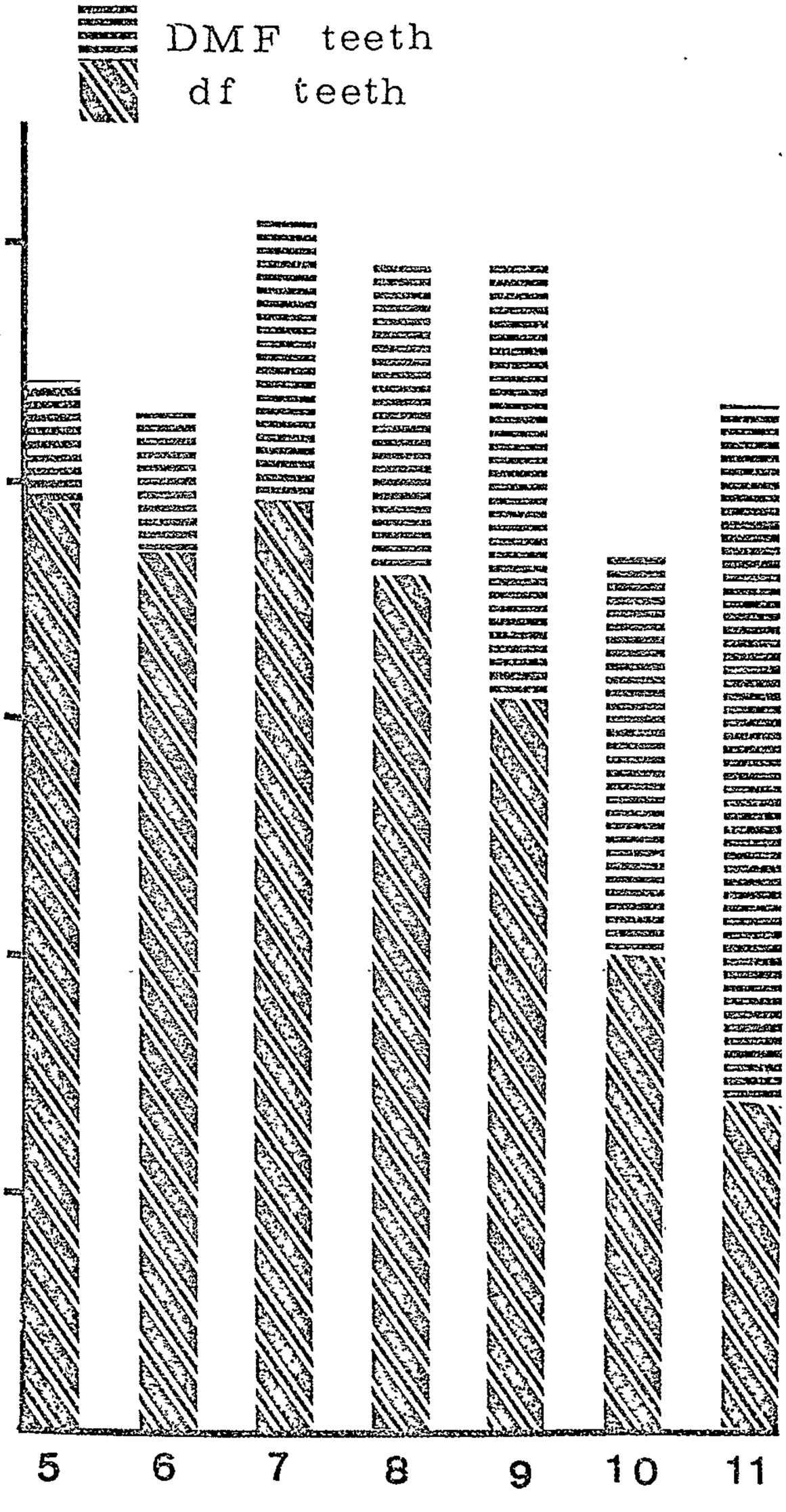


Figure 16

Presenting a graph of the decayed, missing and filled teeth (DMF) of age groups 12 years and over from data on Fig. 13.

GRAPH OF DMF TEETH IN AGE GROUPS 12 YEARS AND OVER

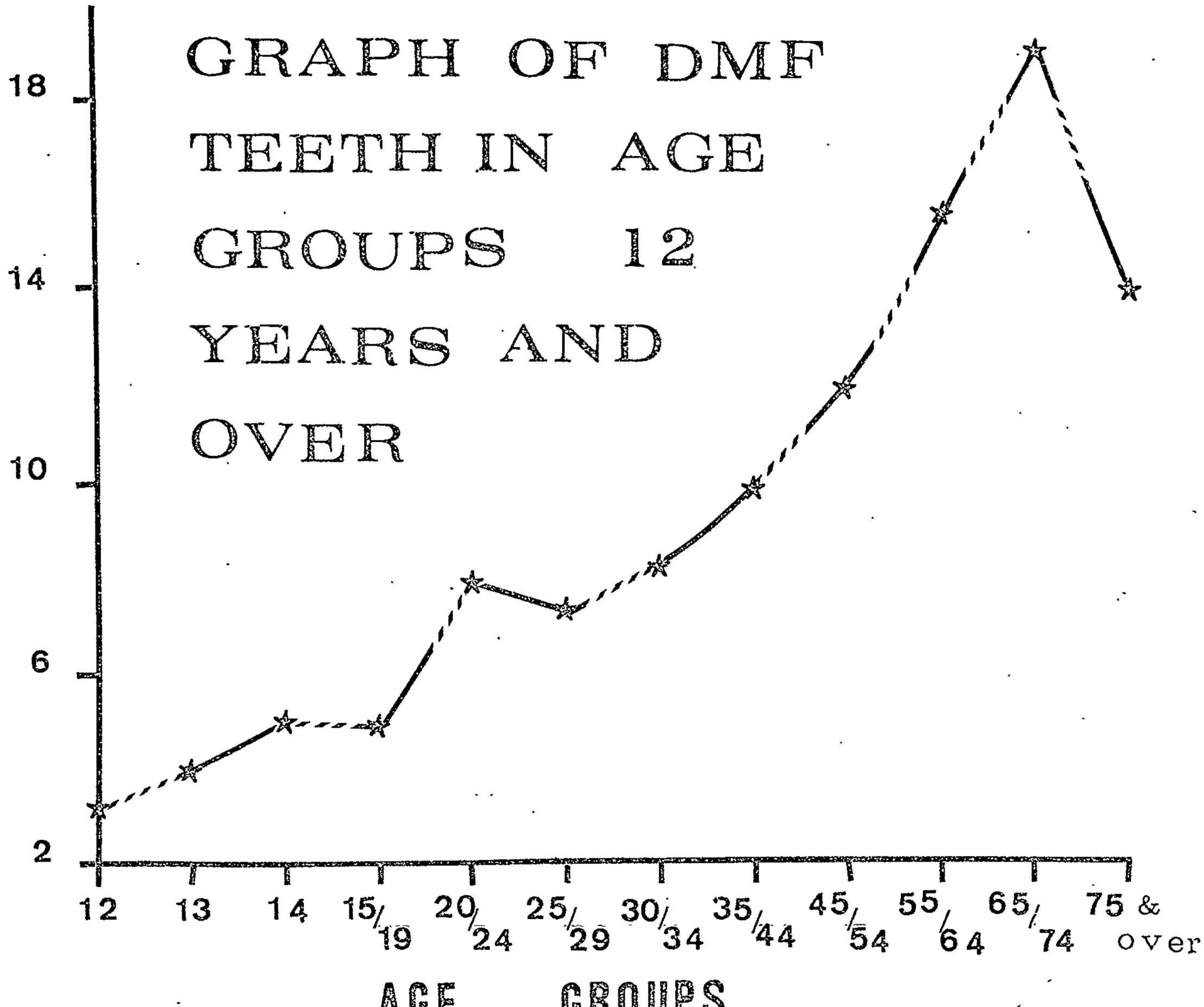
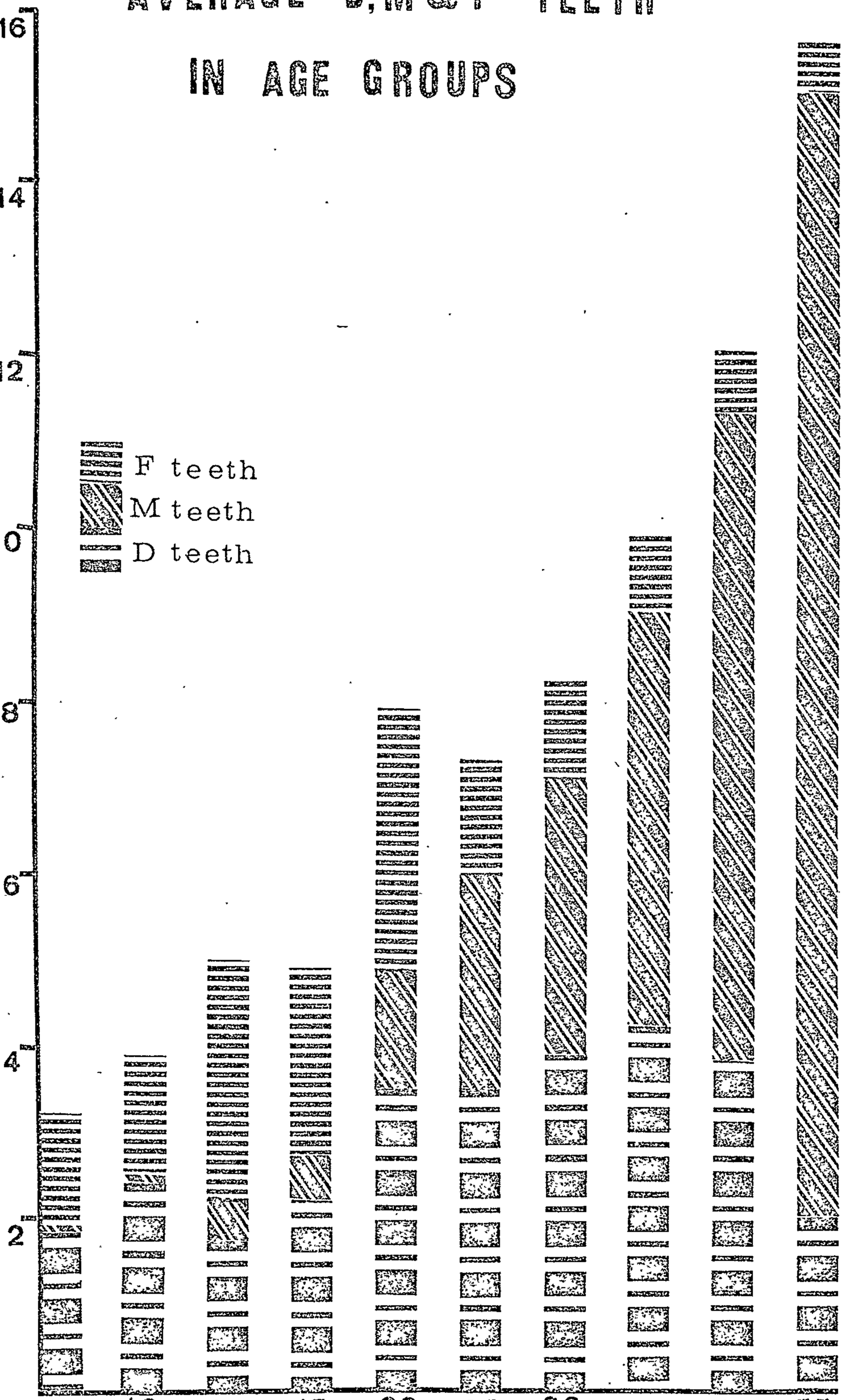


Figure 17

This is a bar graph interpretation of the DMF data presented in Figure 13.

AVERAGE D, M & F TEETH IN AGE GROUPS



2. Oral Hygiene and Periodontal Disease

Results:-

In Figure 12 the periodontal observation recorded was headed "Number of persons with an area of gingival inflammation."

Of the 666 children examined, 608 (91.3%) were recorded as exhibiting gingival inflammation. In the 5 year group 79.5% were so affected - this increased to 97.2% affected at age 11 years.

From Fig. 13 the PI score increases steadily with age (Fig. 18). The DI-S score remains uniform throughout all age groups, falling slightly between 15 and 24 years of age (Fig. 18 and 20). The CI-S score increases with age (Fig. 18 and 20). The OHI-S score increases with age, slight decreases being observed between 14 and 24 year age groups (Fig. 19).

PI, DI-S, CI-S and OHI-S scores are all high.

Figure 18

Presenting a graph of the Periodontal Index (PI), the Calculus Index-Simplified (CI-S) and the Debris Index-Simplified (DI-S) from data in Fig. 13, for age groups 12 years and over. Because of low numbers age groups 65-74 and 75 and over are not significant.

PI and CI-S coefficient of correlation is +0.98 ($P<0.001$).

PI and DI-S coefficient of correlation is +0.48 ($P<0.12$).

The relation of PI to CI-S for individuals was found to be very strong.

The relation of PI to DI-S was only moderate.

Graph of DI-S, CI-S & PI

12 years and over

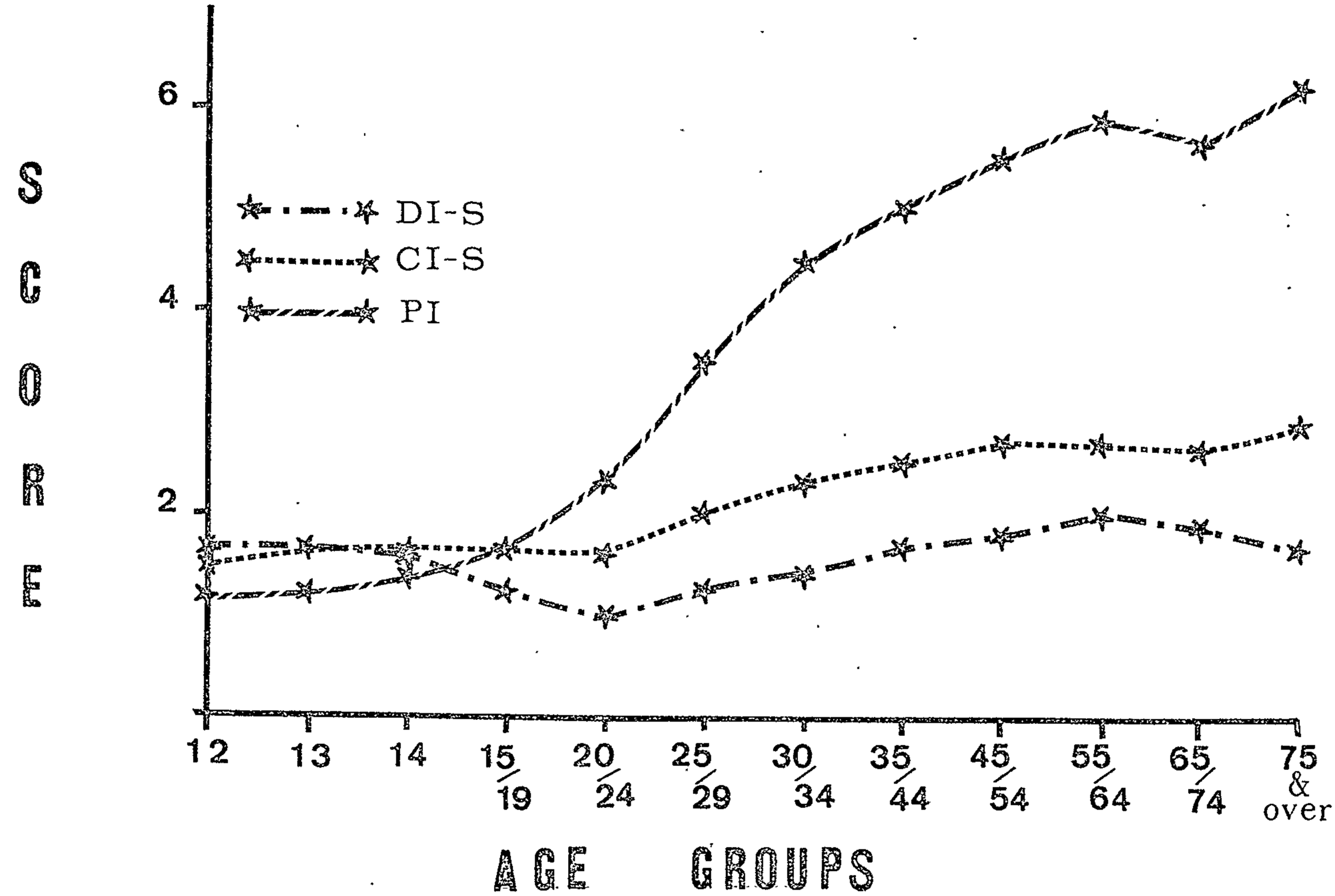


Figure 19

Presenting a graph of Periodontal Index (PI) and Oral Hygiene Index-Simplified (OHI-S) from data in Figure 13 for the age groups 12 years and over.

PI and OHI-S coefficient of correlation is +0.90 ($P<0.01$).

This is a strong relationship.

Graph of PI and OHI-S

12 years & over

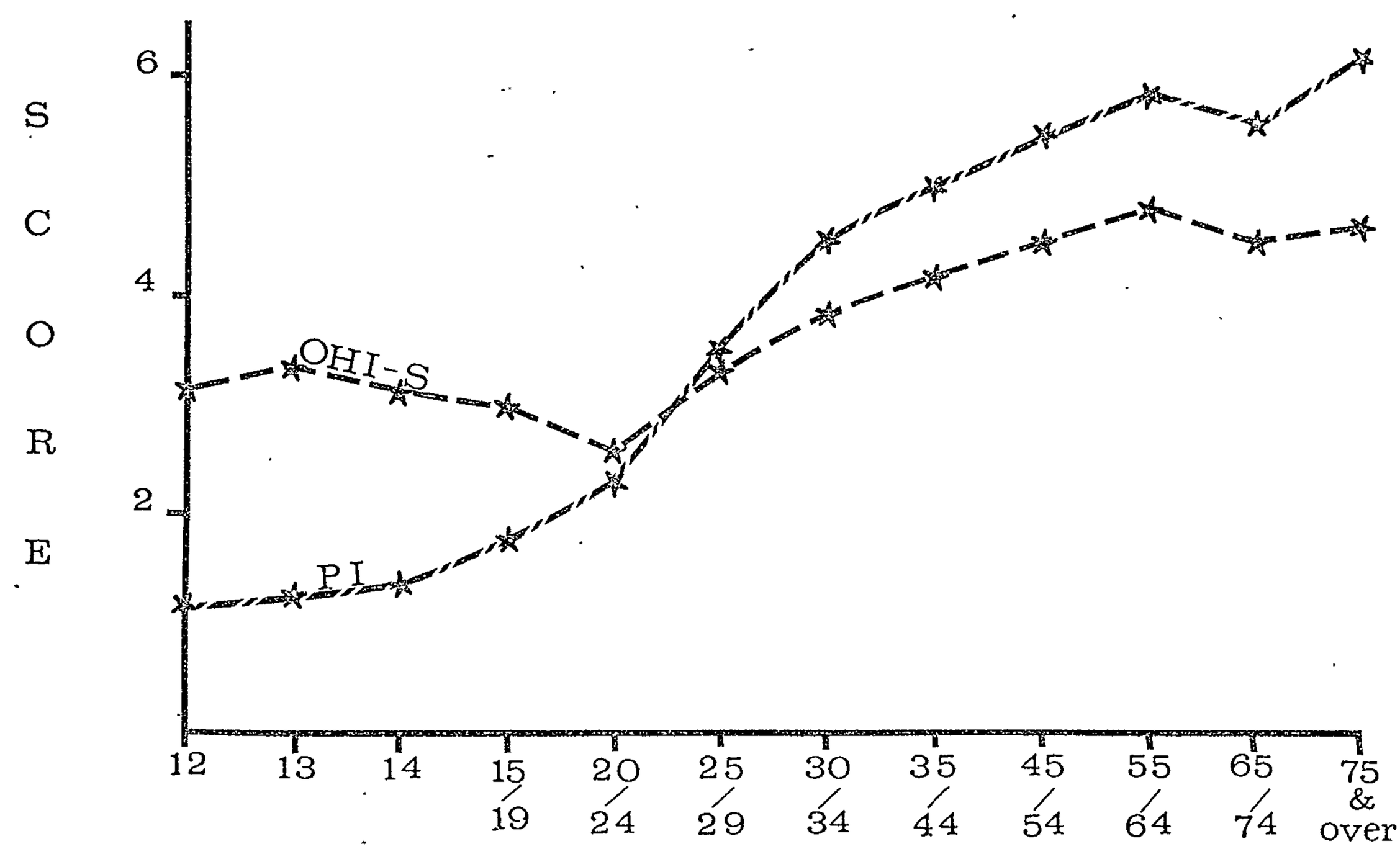


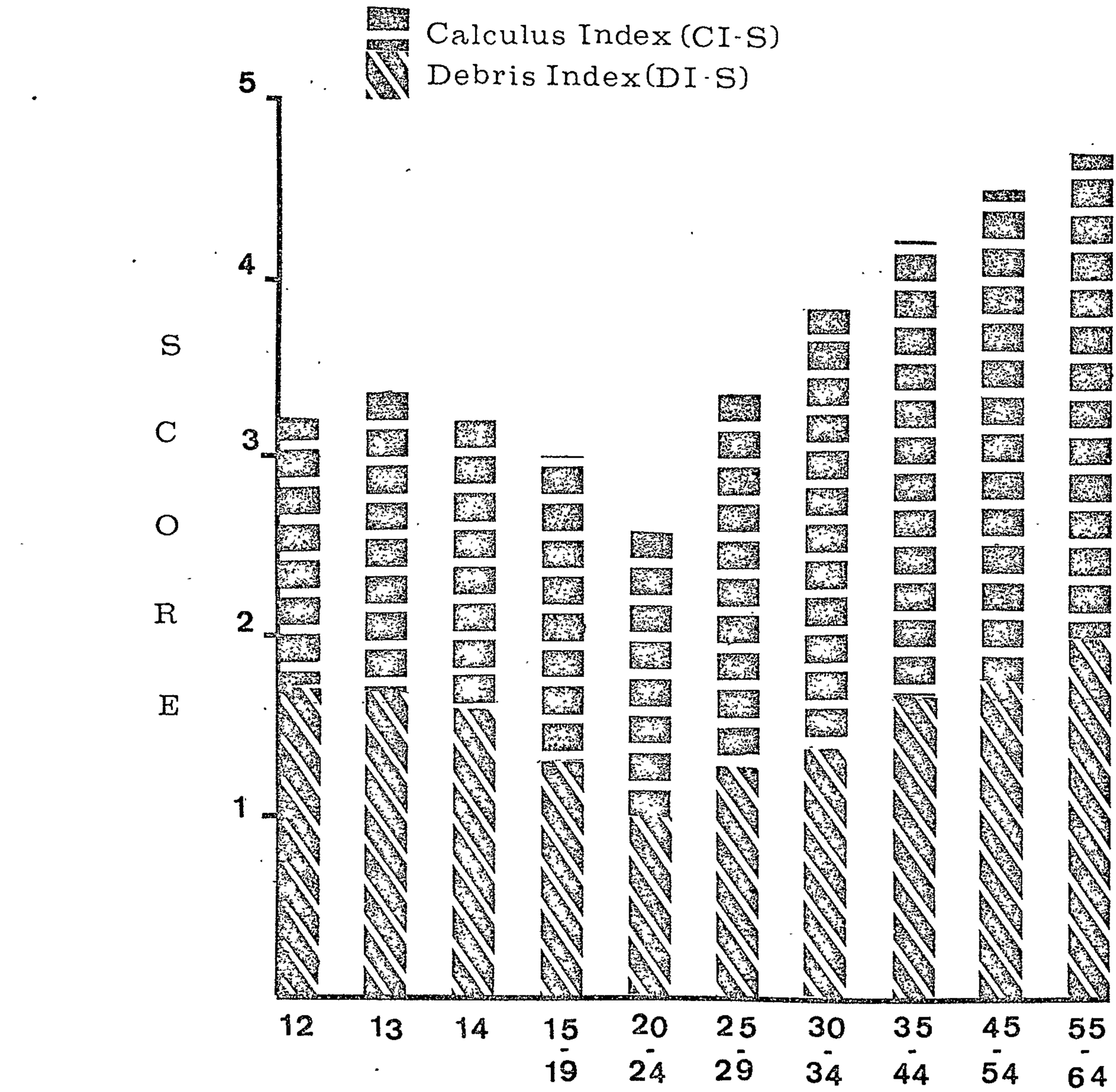
Figure 20

Presenting a bar graph interpretation of the data presented in Figure 13 of the Calculus Index-Simplified (CI-S) and Debris Index-Simplified (DI-S), for age groups 12 years and over.

The top of the column represents the Oral Hygiene Index-Simplified.(OHI-S = DI-S + CI-S).

As was observed in Figure 18, the CI-S increases with age and the DI-S remains reasonably static.

AVERAGE DI-S & CI-S SCORES IN AGE GROUPS



DISCUSSION

1. Discussion of Literature Review

It was found that the following studies did not lend themselves readily for discussion and comparison with the Nauru survey:

(a) Pickerill & Champtaloup (1913[38]):- the age groups were not comparable and there was no record of dental caries or periodontal disease.

(b) Ferguson (1934[16]):- methods and materials for assessment of dental caries were not recorded. Calculus was observed but not described in a manner that allowed comparison. Gingivitis was not recorded to enable comparison. The adult numbers were insufficient for comparison and dental caries description was not compatible with the present thesis methods.

(c) Kirkpatrick (1935[31]):- dental caries was not defined and Nauru did not appear to have a diet similar to that of Manus Island. (Sago and taro were not eaten in significant amounts on Nauru.) No reference was made to material and methods of examination or recording technique. Kirkpatrick's next visit observed periodontal problems. It was not possible to compare his findings as the conditions were not described or defined, age groups were not mentioned and the method of examination was not presented.

(d) Faine & Hercus (1951[15]):- Melanby's system of recording caries and the method of observing "condition of gums" did not enable adequate comparison.

(e) Hubble (1954[25]):- the age groups were not compatible, nor were the criteria for assessing dental caries.

(f) Davies (1956[11, 12]):- in his assessment of the periodontal conditions did not define gingivitis nor were materials and methods presented.

(g) Erana & Macapanpan(1965[14]):- age groups were not in conformity with the Nauru study.

(h) Taylor (1966[49]):- third molars were ignored (only 28 teeth were examined) and radiographs were used on certain subjects. This ruled out satisfactory comparisons.

(i) McDowell (1953[36]):- the discussion of dental caries has been precluded again by the divergent use of age groups.

(j) Barmes (1968[2, 3], 1969[4]):- related dental caries to diet. He, along with most observers, felt confident in his assessment of diet in relation to an area. His age grouping and age numbers were unsuited for direct comparison. He observed a significant correlation between dental caries and oral debris.

The following studies, to a varied extent, lent themselves to comparison with the Nauru study:

(i) Jones, Larsen & Pritchard (1930[26, 27, 28, 29]):- it was observed in the 5-6 year-old group there were 5.9 carious teeth per child - the present Nauru survey of this group showed a combined df, DMF score of 4.4. It might be postulated that the Hawaii diet did in fact lead to an increase in dental caries and that carbohydrates are in part responsible for dental caries.

(ii) Bedkober (1938[5]):- the methods of assessing dental caries and periodontal disease were not satisfactory for discussion; however, he observed that only 37.5% of adults had definite dental caries and very few children were affected. It must be presumed that there has been a great change in the dental caries

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pattern with change of diet since Bedkober's survey. The observance of occlusal wear is interesting. Bedkober felt that little cuspal wear was in evidence; this is in contrast to the observations in the recent survey. The patient in figure 21 was selected as typical example of cuspal wear usually observed. If the average isolated person becomes more exposed to softer foods then one would not expect to see increased occlusal wear. This must emphasise the fact that more stringent criteria for oral examinations must be used.

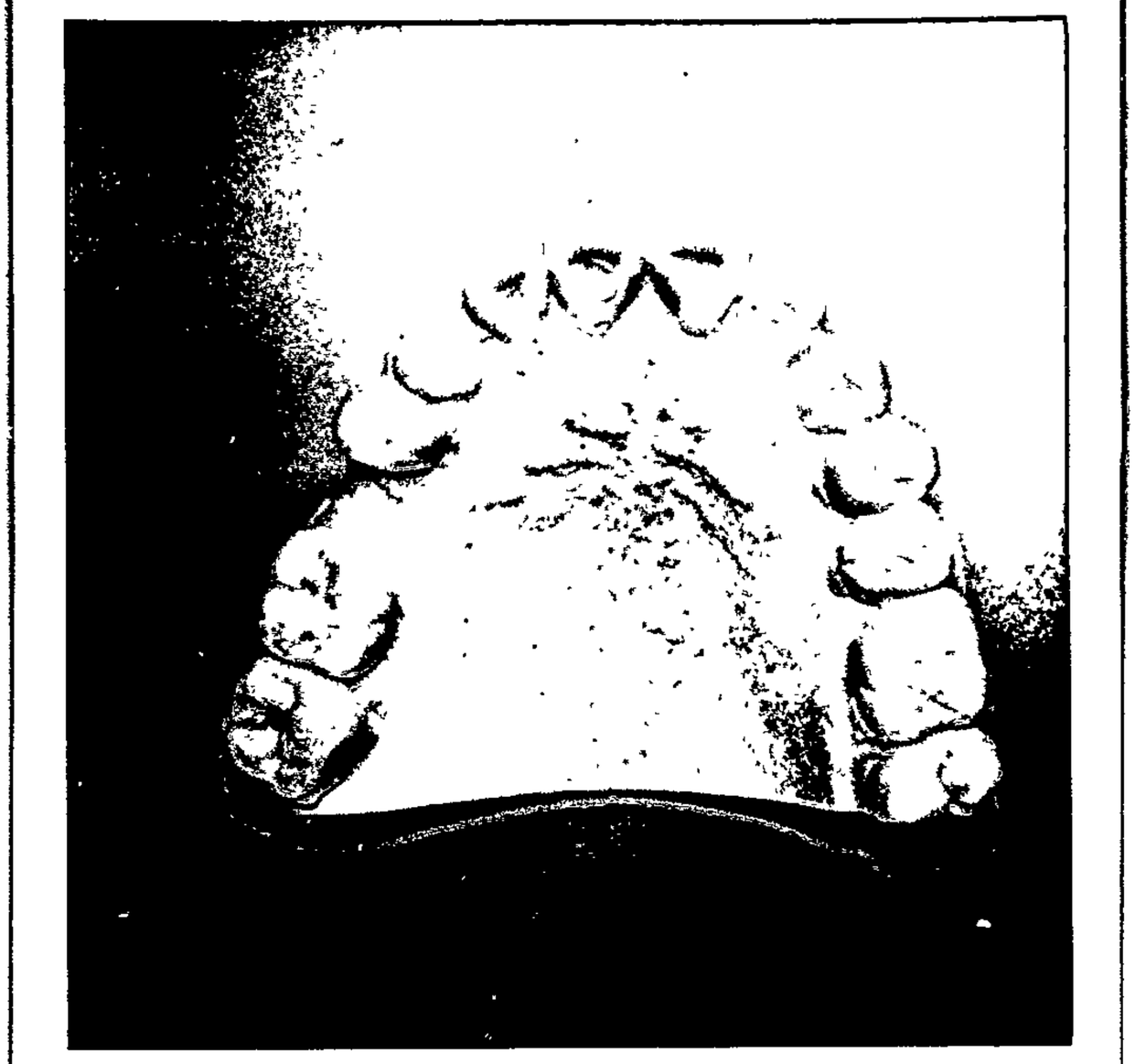
(iii) Saunders & Taylor (1938[46]):- while numbers and methods were in doubt it appeared that the presence of white flour as a substitute for the natural fern root in the diet was capable of altering the dental caries incidence.

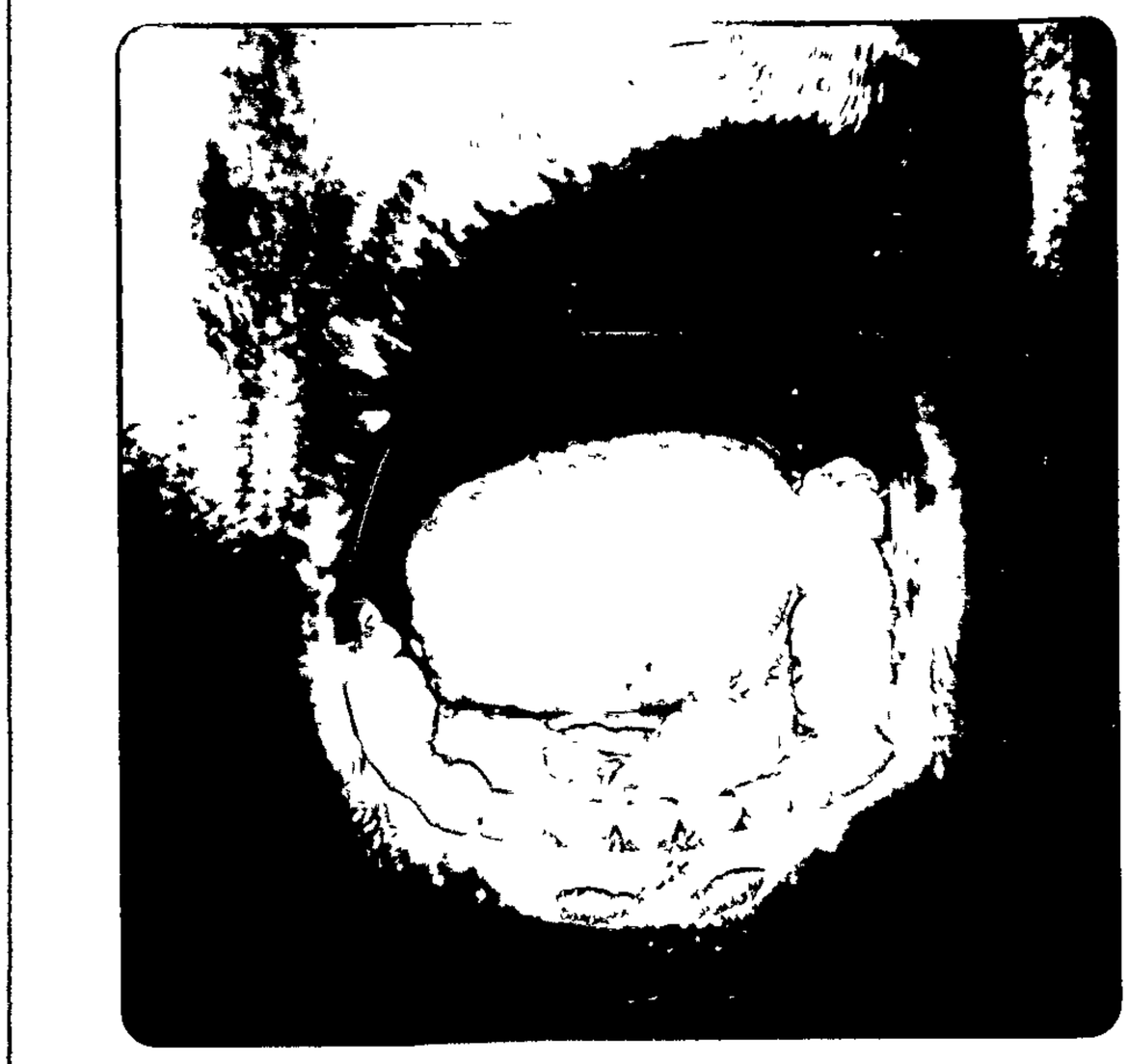
(iv) Williams (1939[53]):- was aware of the age difficulties in examinations. He also observed a variation in dental caries between "remote" and "urban" island children. Nauru, because of size, did not have separate groups so readily identifiable, but it did appear that certain families on the island favoured either "remote" or "urban" diets.

(v) Price (1939[39]):- caries assessment was vague but diet seemed readily ascertainable. Price supported the other observers by placing the low caries incidence in areas of natural "uncivilised" diet.

(vi) Sinclair, Cameron & Goldsworthy (1950[48]):- methods were thoroughly presented. The problems of selecting age groups different to the present Nauru study arose. Regardless of this it became apparent that there were more 6-10 year-olds caries free in the New Guinea study than were observed in Nauru. The access to refined foods on Nauru must be seriously considered as a cause for this difference.

Figure 21





2 photographs illustrating occlusal wear and flattened cusps

(vii) Gerry, Smith & Calton (1952[17]):- criteria for comparison here are possible. Nauru subjects appear to have lower dental caries incidence than that of their counterparts on Guam. The variation could be accounted for by diet and examiner variation.

2. Discussion of Dental Caries

For the age groups 5 to 11 years inclusive the average df teeth per person was 2.9, the average DMF teeth per person was 1.4 and the average df and DMF teeth per person was 4.3.

The incidence of dental caries ranged from age 5 to age 11 being highest at age 7 (df + DMF = 5.1) and lowest at age 10 (df + DMF = 3.7).

The high level of dental caries in the younger age groups points to a more rapid deterioration in the dental health of future Nauruans with an increasing demand for conservative dental treatment.

For the age groups 12 years and over, the df score was not observed.

The DMF score rises steadily with age.

Two points of interest are (i) the high proportion of missing teeth in the older age groups; (ii) the increase in decayed teeth per person in the younger age groups.

The high proportion of missing teeth in the older group is due, in part, to the difficulty in diagnosis of teeth lost through periodontal disease. A more accurate assessment could well reduce the total DMF of these older groups.

Notwithstanding the problems encountered in assessing the diet it can be assumed that the younger age groups are exposed to more refined carbohydrates than were those 20 years ago, resulting in the younger groups presenting a relatively higher DMF value.

The unusual pattern of filled teeth is best explained by the spasmodic dental treatment that has existed on the island,

some age groups being more exposed than others to the attentions of the various dental officers appointed to the island.

3. Discussion of Periodontal Disease

The statistical interpretation of the PI related to DI-S would indicate that there is no significance between an increase in the PI score and an apparent failure to record an increase in the DI-S score (Figure 18). The relation of PI to CI-S was very strong. So it may be assumed that calculus has an important place in the etiology of periodontal disease.

It is possible that DI-S score does not relate to PI in that the debris present is excessive from an early age and so it is only by the continued presence of EXCESS debris and the formation of calculus that the periodontal condition manifests itself. If so, this then becomes significant as a TIME factor is involved.

If all debris and plaque are removed and calculus formation prevented, the gingival sulcus should attain a healthy condition with less abuse from bacteria and their toxins that would initially grow and develop on the supragingival tooth surfaces.

The oral hygiene campaign to reduce the DI-S (as performed by the school dental scheme, Yule (1968[56]), on Nauru) should be expected to reduce the PI score.

The PI and OHI-S scores increase with age (Fig. 19), the OHI-S score is high at the initial age groups recorded (12 years) and apart from a drop in the 20-24 year group the score slowly increases. Day, Stephens and Quigley (1954[13]) observed a fall in gingivitis in the 19-22 year age groups. The PI score increases uniformly with age being low initially but of severe proportions (PI 3.5) before 30 years of age.

From Figure 20 the DI-S is lower in the 20-24 age group

than any other group; four explanations are offered:

a. the examiner was at error;

b. the Greene and Vermillion method is not an accurate tool for recording oral hygiene;

c. this is a true score, this group being more conscious of appearance and who may be more attracted to and by the opposite sex;

d. this group was more profoundly influenced by one of the earlier dental officers than any other.

4. Discussion and Comparison with Other Surveys

As reviewed in the literature, people in many remote areas have been examined and dental health conditions recorded.

The Cadell survey was analysed more thoroughly because df and DMF scores allowed comparison (Figure 22).

DMF and PI scores were compared between Nauru, South Vietnam and the U.S. (Figures 23 and 24).

Figure 22

A graph comparing two examiners, Yule and Cadell, who recorded df + DMF scores on similar age groups in Nauru, with a time lapse of approximately ten years.

Cadell's subject numbers were a little low for age groups 10 and 11 years.

Note the vertical line on the graph commences at the df + DMF score of 2.

The horizontal line represents the age groups from 5 to 11 years.

Comparing two DMF+df scores on Nauru Island

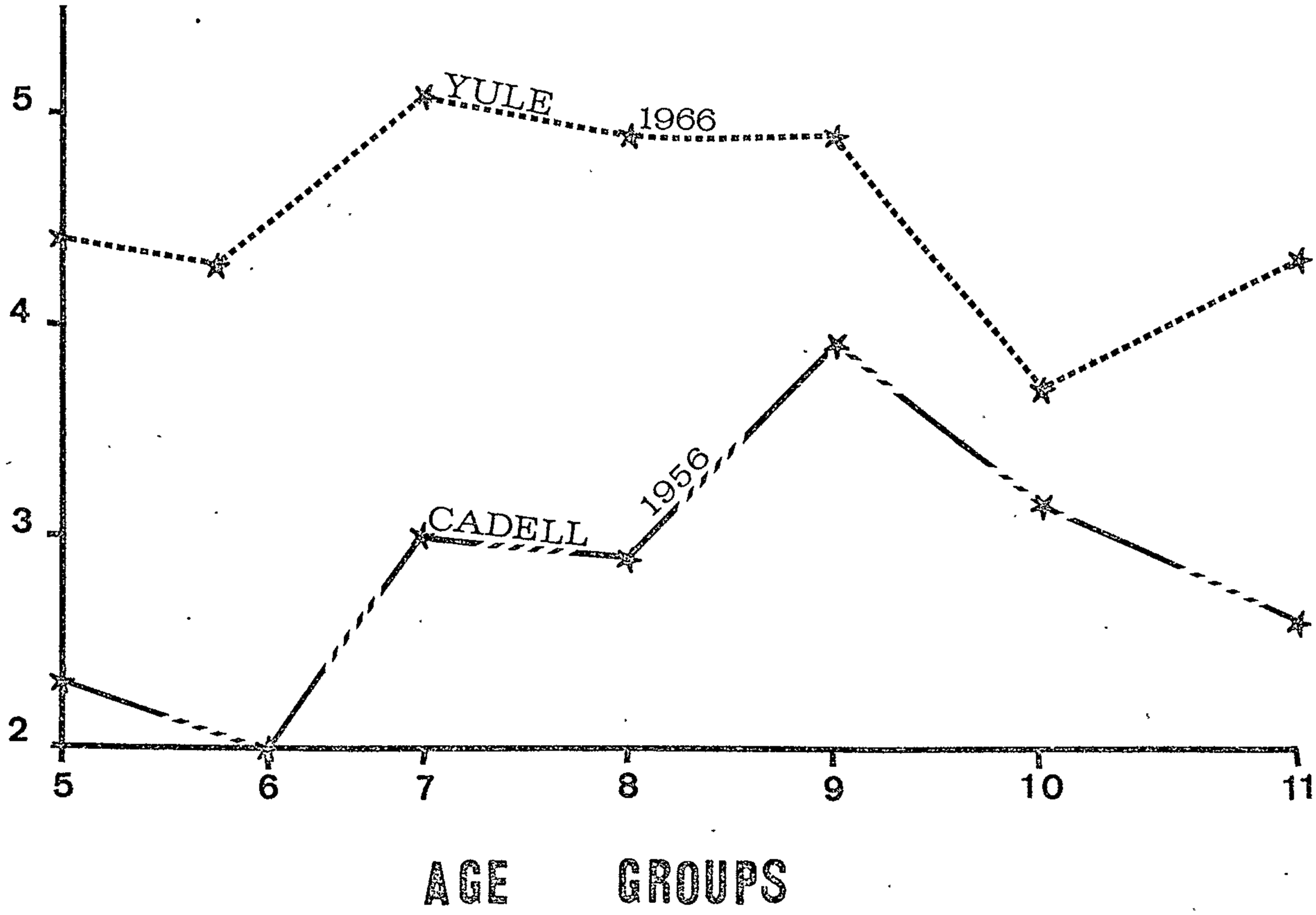


Figure 23

A graph of DMF scores from Nauru (Fig. 12) and South Vietnam and Maryland, U.S. (Russell, Leatherwood, Hein and Van Reen, 1965[44]).

The South Vietnam figures were chosen partly at random and partly because the author feels these people resemble the Nauruans physically.

The Maryland figures are not meant to represent the U.S. but were included as they were presented by Russell, Leatherwood, Hein and Van Reen, and as they do represent a Caucasian group eating refined foods.

COMPARING THREE DMF SCORES

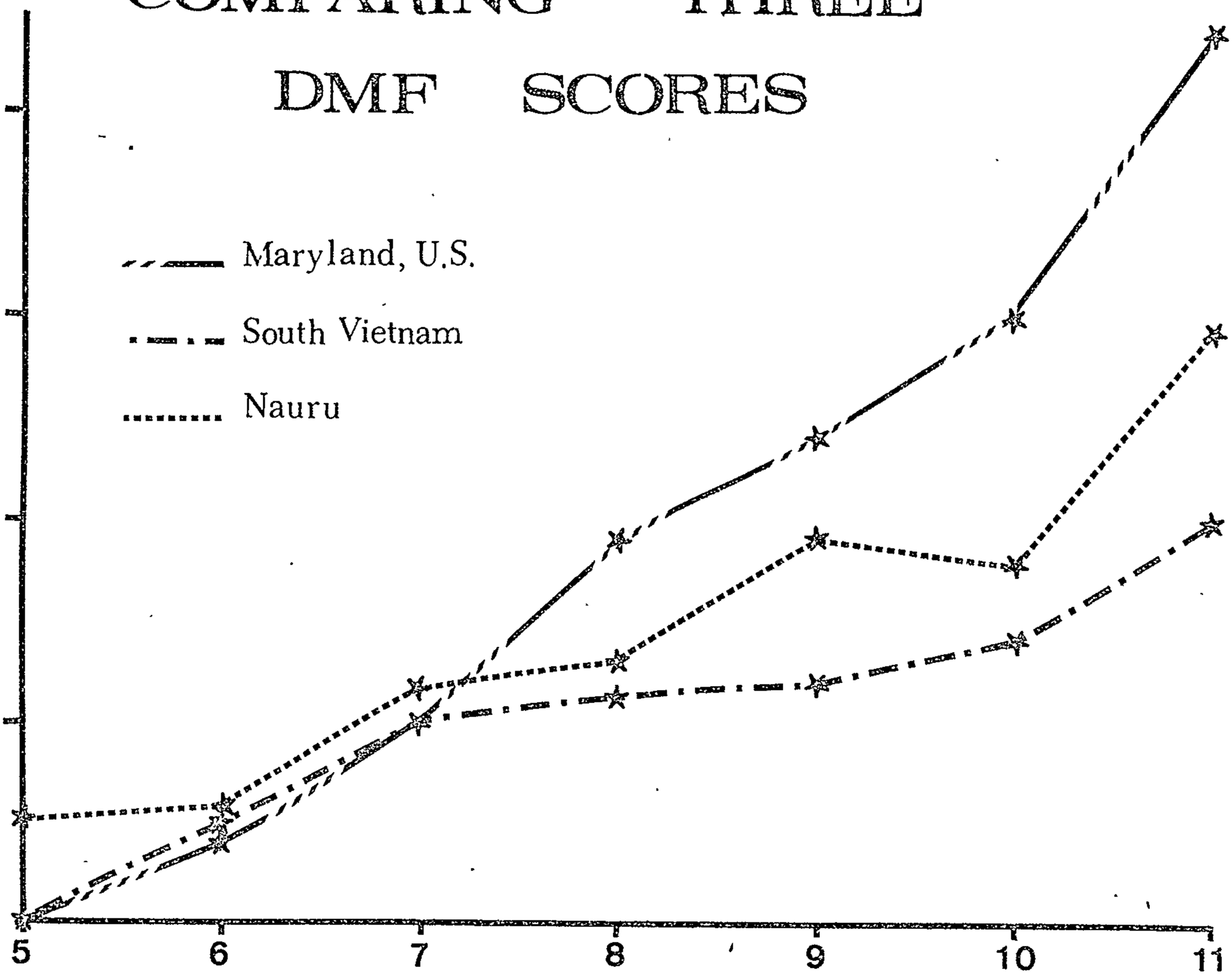
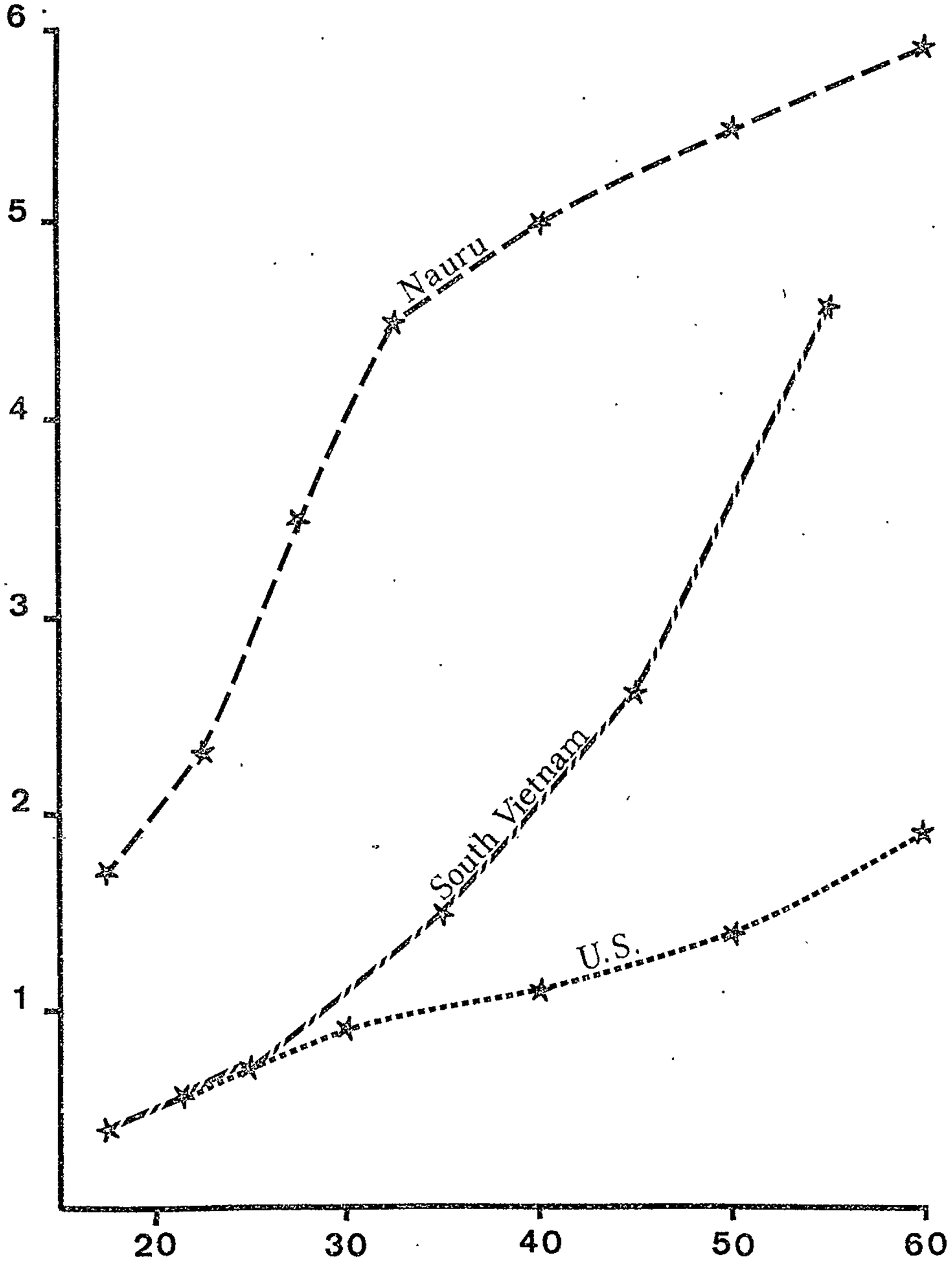


Figure 24

A graph of the Periodontal Index recorded in Nauru by the author, South Vietnam by Russell (1963[42]) and the U.S. by the U.S. Department of Health (1965[51]).

COMPARING THREE PI SCORES



Assuming Cadell scores dental caries low and the author scores high (this is unlikely - see Methods - standardisation) it must be concluded that dental caries is increasing on Nauru (Fig. 22).

From the brief history of Nauru it is obvious that the Nauruan way of life is changing and so dietary and oral hygiene habits also may be changing. As others (8, 14, 16, 24, 36, 39 & 49) have observed, dental caries increases when an isolated group of people become exposed to different diets of a more refined nature. The Nauru results support this.

On examining the DMF scores from Nauru, South Vietnam and the U.S. (Fig. 23) it will be observed the South Vietnamese children are least affected by dental caries while the Maryland, U.S. children are the most affected,with the Nauruan children being at an intermediate level. As Russell, Leatherwood, Hein and Van Reen (1965[44]) describe the South Vietnamese teeth, "caries experience in the permanent teeth of these people was low by whatever method of estimation", natural fluoride being absent, diet must be considered.

Associating refined carbohydrates and dental caries, we may assume that the Nauruans' diet contains more refined carbohydrates than that of the South Vietnamese, but less than that of Maryland children. Assuming that there is no significant examiner difference between the Nauru and Maryland figures, closer scores would be expected, as the Nauruan children appeared to have a diet heavily inclined to refined carbohydrates.

Thus the possibility of some intrinsic factor must not be ruled out; Mellanby's (1923[35]) and Neuman and Di Salvo's (1956[37]) altered tooth structure theories may have a place in

øtherwise inexplicable changes in DMF scores.

The three PI scores on Fig. 24 were chosen to compare Periodontal Disease on Nauru with other racial groups.

If the examiners are all uniform then the Nauruans are in a very poor state periodontally. However, one may argue the Nauru survey was using the criteria for assessing the PI score too stringently.

As is observed for Fig. 24, the PI score for Nauruans at age 20 is as high as the PI score for the U.S. persons aged 60.

Whilst the PI scores for South Vietnam are consistently lower than those of Nauru, as mentioned previously, this could be due to examiner error. Ignoring examiner variation, Nauru has a higher incidence of Periodontal Disease and Dental Caries than has South Vietnam (Figs. 23 and 24).

Also Nauru has a higher incidence of Periodontal Disease and a lower incidence of dental caries than certain groups in the U.S. (Figs. 23 and 24). This may support the theory of an apparent antagonism between caries and periodontal disease (Bibby, 1953[6]).

5. Discussion comparing WHO and Cadell's System of Survey

Discussion of the WHO [55] system as used in the present survey compared with the methods used by Cadell[9] in 1958.

Dental Caries:-

Cadell used a DMF score similar to WHO but included a count of X (where teeth were in need of extraction) in the "D" score.

WHO recommended a "df" system for scoring decayed (d) and filled (f) primary teeth - Cadell attempted to determine the reason for a missing tooth and presented a dmf system with "d" and "f" similar to WHO but "m" representing a tooth that had been extracted.

The use of lighting and instruments was similar in both surveys. Cadell's criteria for presence of caries were similar to those of the WHO protocol.

Periodontal Disease:-

Cadell examined 450 patients in a separate survey for evidence of periodontal disease. His criteria for periodontal disease were the same as used by Davies (1956[12]) - "O = no gingivitis in any region of the mouth" through 1 = mild gingivitis, 2 = moderate gingivitis, 3 = severe gingivitis and 4 = severe gingivitis with associated general periodontitis. This is far removed from the WHO recommended PI and as such leaves it in the limbo of the many other world-wide surveys. There seems no doubt in the minds of the members attending the Conference on clinical methods of periodontal diseases held on May 20 - May 23,

1967, at the University of Pennsylvania, U.S.A., Russell (1967[43]), that the PI is an established and useful epidemiologic tool.

Oral Hygiene:-

Oral hygiene was not recorded as such by Cadell but he did record the presence of supragingival and subgingival calculus and it was graded in three degrees, slight, moderate and severe. The method recommended in 1961 by the WHO Series No. 207 [(54)] was the OHI which was later modified by its developers Green and Vermillion to the OHI-S and has also received further recommendation as an epidemiologic tool by Greene (1967[19]).

Age Groups:-

Cadell complied with the age groups from 5-15 years as recommended by the WHO while observing dental caries - no adults were examined for dental caries. For periodontal disease his age groups went as follows:- 4-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years, 26-30 years, 31-35 years, 36-40 years and 40 and over years - his total group being 430 persons. Calculus was not related to age groups but only to the five groups of periodontal levels. The Figures 12 and 13 reporting this survey and patterned on the chart recommended by the WHO of course bear no resemblance to those of Cadell and so make comparisons unsatisfactory. With reference to the dental caries survey, of 416 persons 5-16 years of age, Cadell[(9)] states in his discussion (p. 53) "It is unfortunate that the author did not record the data separately for deciduous and permanent teeth, as this limits the value of the survey in many

ways." However, it was possible to compare the (df + DMF) score satisfactorily with the present survey (Figure 22).

SUMMARY

A dental health survey of Nauru was proposed in 1965.

The literature was reviewed for methods of recording oral hygiene, dental caries, periodontal disease and surveys of other isolated people.

Nauru was described and the language, customs and economics were observed.

An examination chart was designed and the indices selected were based on WHO protocol.

A Dental Health Survey was performed and 1,420 Nauruans were examined from an eligible population of 2,038.

Standardised criteria for recording dental caries and periodontal disease were proposed. The indices used were, df and DMF teeth per person, the Periodontal Index and the Oral Hygiene Index - Simplified.

The results were statistically analysed for Standard Errors and Standard Deviations. The statistical significance of the coefficient of correlation between PI and DI-S, PI and CI-S and PI and OHI-S was observed.

Due to factors of language, shyness and unintentional distortion of truth, a dietary survey in Nauru was not practicable.

The results of the survey were presented in a Dental Health Survey Report Form patterned on WHO design.

Dental caries in children was low with an average df score of 3.9 at age 5 years and a DMF score of 2.9 at age 11years. In adults the D, M and DMF indices increased with age, but the average F teeth decreased with age. There was a more rapid increase in caries in the younger groups up to 20-24 years.

The OHI-S increased with age, the ages between 14 to 24 years being slightly lower than the overall pattern. This was influenced by a reduction in the DI-S score in the 14 to 24 age groups. The OHI-S score was high.

Periodontal disease in the age groups 5-11 years was recorded as presence or absence of gingivitis; this was high with 91.3% affected. In the age groups 12 years and upwards the PI increased with age. The PI for 12 year-olds was 1.2 and this increased to 5.9 for the 55-64 year group. The PI was high.

The df + DMF survey of Cadell in 1956 was compared with the present one; it showed the extent of dental caries on Nauru was increasing. The DMF and PI scores on Nauru were compared with South Vietnam and the U.S. The DMF score in Nauruans while high in the early years (5-7), levelled out to be midway between the U.S. and South Vietnam at age 11.

Comparing the PI score between Nauru, South Vietnam and the U.S. it appears the increased PI with age is similar between Nauru and South Vietnam. Also the overall PI in Nauru is slightly higher than in South Vietnam and markedly higher than in the U.S.

The WHO Dental Health Report Form is more embracing than Cadell's but failed to mention the importance of adequate numbers for statistical evaluation.

The only comparison possible between the survey of Cadell and the one presented was of the DMF + df teeth in the 5-11 year groups.

The accurate assessment of age in the adult groups appears a common Pacific Island Problem.

CONCLUSIONS

(1) Nauruans still have teeth relatively free of dental caries but they are deteriorating, no doubt due to changes in dietary patterns.

(2) It is impossible to gain the confidence of the Nauruans in such a short period as 2 years, and this must influence any observations made about them. This is of special import where dietary pattern assessment is attempted.

(3) Periodontal disease amongst Nauruans is much higher than many other countries.

(4) There appears to be a positive relationship with periodontal disease and oral hygiene as recorded by PI and OHI-S indices and the CI-S component.

(5) It was not possible to satisfactorily compare the survey by Cadell with the present one of the author except for dental caries in children.

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