Campbell [29] in 1967 stated that most reports have been based largely on a comparison of the hospitalised non-diabetic patient with the hospitalised diabetic patient, and he suggested it may be found that if the "healthy" non-diabetic patient was compared with the "healthy" diabetic patient there may not be any excessive demonstrable periodontal differences. The results of such a survey were reported by the author [28] in 1965. No facts or figures were shown; however he stated that differences in the periodontal disease did exist between the two groups, and that at the same age the diabetic patient had a higher periodontal index than the non-diabetic patient. Campbell also stated that the diabetic patient, in general, had higher calculus and debris indices than the non-diabetic. He also contended that if the periodontal index of the patients in both groups was compared at the same debris and calculus index, the diabetic was affected significantly by the amount of oral debris but not calculus, and that the diabetic patients who brushed their teeth three times a day had a periodontal score which was lower than in those patients who brushed their tooth once or twice a day. As this study has not been published and only a short report given, it is not possible to give any credence to these facts until the

full report has been studied.

Bonvonisto, Taylor and Connolly [14] in 1967 in a study of fifty-three diabetic patients and seventy-one non-diabetic patients, stated that comparisons of gingivitis, calculus formation and pocket depth failed to show any significant difference between diabetic and non-diabetic patients. The authors of this survey state that the difference in the results recorded in this study from other recent studies may be due to:-

1. The findings represent quantified data and not clinical impressions.
2. The use of relatives as the control group would minimise differences.
3. Uncontrolled diabetics might well present an entirely different clinical picture from the controlled diabetics used in this study.

Bonvonisto and his co-workers [14] used only two age groups - five to sixteen years of age and seventeen to seventy-two years of age. The larger number in the young group and the possibility that the older group could be made up of a large portion of individuals under thirty years of age make the figures in this study suspect.

Summary

The major portion of the revieved literature contends that periodontal disease is more severe in diabetic patients. Unfortunately most of those authors are only expressing a clinical opinion. Of those authors who agree that there is an altered reaction to periodontal disease in diabetics; Rutledge (132), Rudy and Cohen (125) Ziskin, Loughlin and Seigel (169) (170); Marble (96), Amies and Parks (3), Ray (120), Stahl (150), Ray and Orban (12), Williams and Mahan (164) and Stahl, Witkin and Scopp (154) expressed a clinical impression. Pollock, Person and Knishkowy (116), Sindoni (148), Gottsegon (63), McCarthy and Shklar (93), Levine (86) and Ramfjord and his co-workers (118) revieved the literature, Shklar (146), Cohen (35) and Bissada (12) and their respective co-workers based their agreement on animal studies; Campbell (28) reported a study without any details; only the study of Belting, Hiniker and Dummett (11) used a universally recognised periodontal disease index over a wide range of ages and with good controls.

Of the authors who disagree that there is an increased severity of periodontal disease in diabetes, Shoppard (143) and Baird (6) expressed a clinical impression, Schour and Massler (137) and Golomb (61) revieved the

literature, Glickman [58] based his disagreement on animal studies; Shannon and Gibson [141] and Benviste, Bixler and Conneally (I4) used controls, a reasonably efficient periodontal index, but a very limited age range.

The Alabama group [140] [31] [32] would have to prove that their patients were suffering from a true decreased glucose tolerance, rather than some transient stage which could possibly be precipitated by the patient's anxiety. Glucose tolerance varies with age, time of day, health and shock, and therefore one test showing decreased glucose tolerance is not in itself diagnostic of diabetes mellitus, only if other tests - urine, insulin, etc., and other symptoms - polyuria and polydipsia are present could these patients be considered diabetic. It is considered that the figures set down by Rosenthal and Barry [107] which this group used, were far too limited and much higher scores must be recorded before a patient is considered diabetic [70] [158].

4. CLINICAL SURVEY OF THE PERIODONTAL CONDITION OF DIABETIC AND NON-DIABETIC PATIENTS IN SYDNEY

A. METHOD AND MATERIAL

The results of this investigation were based on the examination of one hundred and thirty-four patients. Sixty-seven patients had been diagnosed as diabetic and had no other known medical complication. Sixty-seven patients were considered "healthy" with a negative medical history. Thirty-three of the diabetic patients were attending the diabetic clinic at the Royal Prince Alfred Hospital and thirty-four were attending the Royal North Shore Hospital diabetic clinic. The non-diabetic healthy patients were staff and patients of the Royal North Shore Hospital. The non-diabetic patients examined were taken from the post-orthopaedic clinic if the injury could be considered not to have interfered with their normal oral hygiene and if they had not been on recent antibiotic treatment.

The survey was carried out to determine whether diabetes mellitus had an effect on the severity of periodontal disease. To try and evaluate the effects of diabetes mellitus on the periodontal tissue status, as many known variables which would influence periodontal

disease were kept constant between diabetic and non-diabetic patients. The age group chosen for this survey was twenty-five to forty-nine years of age; unfortunately this group constitutes the smallest number of patients attending the diabetic clinics used in this survey; because of this fact a great deal of time was necessary to acquire a suitable number of patients.

All patients examined had a medical history folder supplied by the clinic they were attending or by the staff health centre of the hospital.

One of the basic methods of research of any disease is the epidemiologic study, only in more recent years have epidemiological methods been used in periodontal research. There is no general agreement on the exact criteria for registering periodontal disease. This is demonstrated by the many separate epidemiological studies conducted in the past few years. Most of those studies use a quantitative numerical system which has been established by the investigator himself to register the extent of periodontal disease; from this data a population index is computed (65). For practical reasons, the criteria represent evaluations of visible signs of periodontal disease believed to have clinical significance. Simplicity of method is necessary so that the

investigations may be applied to large numbers of patients with a minimum use of instruments and personnel. To accomplish this simplicity, some of the indexes have been so condensed that they yield little information. A number of indexes however have been designed which provide significant estimates of the prevalence and incidence of periodontal disease.

Grant, Stern and Everett [65] consider that one of the simpler, yet useful indexes which is designed to evaluate the presence, degree and location of soft debris and calculus on the tooth surfaces is the index which was designed by Greene and Vermillion [67]. It is very useful since these potentially etiological factors in periodontal disease may be correlated with the severity of periodontal disease. They incorporated this information into the debris index, the calculus index and the oral hygiene index [65].

Russell's periodontal index [126] is perhaps one of the more efficient indices in current use. This index assigns a numerical value to the severity of the gingival inflammation based upon its extent, as well as a value for the level of periodontal destruction. In this index the numerical values for the periodontal status are greater than those for the gingival conditions. This provides an

index number which increases in relation to the increased loss of periodontal support.

The oral hygiene index which was designed by Greene and Vermillion [67] and the periodontal index designed by Russell [126] were used in this survey.

The survey consisted of a clinical examination of the periodontal tissue with the aid of a mouth mirror, a probe no.23, a periodontal probe graduated in millimetres and a clip blower. The examination of the patients at the Royal North Shore hospital was carried out in the dental clinic of this hospital, a portable headrest and light were used to examine patients at the Royal Prince Alfred hospital. An explanation of the oral hygiene index and the periodontal index used in this survey follows:-

Greene and Vermillion's Oral Hygiene Index [67]

The oral hygiene index is composed of the debris index and the calculus index. Each index is based on a number which represents the amounts of debris or calculus found on the buccal or labial and lingual surfaces of each of three segments of the maxillary and mandibular dental arches. The segments are:-

1. The segment distal to the right cuspid.

2. The segment mesial to the right and left first bicuspids.

3. The segment distal to the left cuspid.

Separate recordings are calculated for the buccal and lingual surfaces as the oral hygiene may vary between these surfaces. The individual indices are derived from scores which record the fraction of tooth surface covered by debris or calculus. Scores are only recorded for fully erupted teeth. (A tooth is considered to be fully erupted when the incisal or occlusal surface has reached the occlusal plane.)

In this examination, each buccal, labial or lingual surface is considered to encompass half the circumference of the tooth. In other words the buccal surface includes the buccal half of the mesial and distal surfaces and the lingual or palatal surface includes the lingual half of the mesial and distal surfaces.

Oral debris is the soft foreign matter adhering to the surface of the teeth, it consists of mucin, bacteria and food.

The oral debris scores recorded for a segment are of the lingual and buccal surface having the greatest area covered by debris, the buccal and lingual score need not be taken from the same tooth. The surface area covered

by debris is estimated by running the side of a sickle-shaped explorer along the buccal, labial or lingual surfaces and noting the occlussal or lingual height of the debris, as it is removed from the tooth surface.

There are two scores for each segment in which there are fully erupted permanent teeth present, one score for the buccal surface and one score for the lingual surface. The scores and criteria for oral debris are:-

Score 0. no debris or stain present.

Score 1. soft debris covering one third or less of the tooth surface, or the presence of extrinsic stains without other debris, regardless of area covered.

Score 2. soft debris covering more than one third, but not more than two thirds of the tooth surface.

Score 3. soft debris covering more than two thirds of the tooth surface.

Criteria and scores for classifying calculus.

Dental calculus is defined as a deposit of inorganic salts composed primarily of calcium carbonate and phosphate mixed with food debris, bacteria and desquamated epithelial cells. Dental calculus is divided into two

types, differentiated primarily by the location on the tooth surface in relation to the free gingival margin.

1. "Supragingival calculus" - denotes deposits located occlusal to the free gingival margin and usually white to yellowish brown in colour.
2. "Subgingival calculus" - denotes deposits located apically to the free gingival margin, which are usually light brown to black in colour because of the inclusion of blood pigments.

Only hard deposits of calculus are recorded. Segments which have one or more permanent teeth are given two scores - one score for the buccal surface and one score for the lingual surface in each segment. These two scores need not be taken from the same tooth.

The scores and criteria for oral calculus are:-

Score 0. no calculus present.

Score 1. supragingival calculus covering not more than one third of the tooth surface.

Score 2. supragingival calculus covering more than one third, but not more than two thirds of the exposed tooth surface or the presence of individual flecks of

subgingival calculus around the cervical portion of the tooth or both.

Score 3. supragingival calculus covering more than two thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both.

Calculation of the indices.

To determine an individual's debris index, the debris scores were totalled and divided by the number of segments scored. The same method is used to determine the calculus index. The oral hygiene index is found by adding the debris index and the calculus index. The debris and calculus indices each have a possible score of nought to six, and so the oral hygiene index can range from nought to twelve.

If there is no doubt about which score to assign in the debris or calculus scores the lesser value is recorded.

The Periodontal Index.

The periodontal status of each patient was scored by the method described by Russell (126). The examination was carried out with a mouth mirror, chip blower and a graduated periodontal probe under good lighting.

Russell's Periodontal Index (126) is based upon the signs of periodontitis and the sequence in which they usually appear - inflammation of the gingiva, pocket formation and loss of function. Each tooth is scored; the scores are totalled for the upper and lower dentition and then the total of these two scores is divided by the number of teeth present. This score for each patient represents the average condition of the teeth in his mouth.

Scoring and Criteria for the Periodontal Index.

Score 0. Negative. There is neither overt inflammation in the investing tissues nor loss of function due to destruction of supporting tissue.

Score 1. Mild Gingivitis. There is an overt area of inflammation in the free gingiva, which does not circumscribe the tooth.

Score 2. Gingivitis. Inflammation completely circumscribes the tooth, but there is no apparent break in the epithelial attachment.

Score 4. Roentgenographic examination not used in this survey.

Score 6. Gingivitis with pocket formation. The epithelial attachment has been broken and there is a pocket (not merely a deepened gingival crevice due to swelling in the free gingiva). There is no interference with normal masticatory function, the tooth is firm in its socket and has not drifted.

Score 8. Advanced destruction with loss of masticatory function. The tooth may be loose, may have drifted, may sound dull on percussion with a metallic instrument, may be depressible in its socket.

When in doubt which score to apply to the individual tooth, the lesser score is used.

Russell (131a) in a discussion of his index points out that patients having a score of zero to .1 or .2 may be considered to have minimal gingivitis. Those with significant gingivitis ranging upward toward incipient destructive disease usually scored in the range of .5 to 1.9; those with frankly established destructive disease from 1.5 to 5.0; and those with disease in terminal stages from about 4.0 to 8.0 - the maximum score.

The following information was also recorded for each

patient:- the date of examination, the time of day at which patient was examined, the suburb in which the patient lived, the sex of the patient, the age of the patient, the patient's occupation, an assessment of the patient's educational standard, where the patient was born, where the patient's parents were born, the number of times a patient brushed his/her teeth daily and whether the patient smoked and if so how many cigarettes smoked in a day.

Further facts were recorded for the diabetic and non-diabetic patient. For the diabetic patient; the period of time he/she was known to be diabetic was recorded, the method of diabetic control was divided into four categories, which is a slightly abbreviated form of Belting, Hinkler and Dummett's [10] charting in that the second and third form of treatment - that is orinase and diabinese tablets, have been combined into the one category recorded as Tablets. This gives the following categories with Belting et al.'s listing of what constitutes the different degrees of severity.

1. Diet - very mild.
2. Tablets - mild.
3. Insulin - less than thirty units of insulin per day - severe.

4. Insulin over thirty units per day - very severe.

The state of control was recorded according to Ray's (120) category, which is as follows:-

1. Poor control-glycosuria frequently present.

2. Fair control-glycosuria occasionally present.

3. Good control-no glycosuria present.

Also recorded for the diabetic patients was whether arteriosclerosis and/or retinopathy was present. Ditzel and Sagild [45] contend that ninety-two per cent of patients who have had diabetic inception in youth and have had diabetes for twenty years showed vascular degeneration in the smaller blood vessels.

For the non-diabetic patients, whether they had any diabetic relatives was recorded. Diabetes is certainly hereditary and generally believed to be inherited through a common autosomal recessive gene [77a]. In view of the frequency of the gene, a parent-child inheritance will often appear clinically. Roughly twenty per cent of children with an affected parent may be expected to become diabetic themselves. There is more chance of developing diabetes if one has a diabetic mother than a diabetic father. Prediabetes can therefore be suspected in anyone with a strong family history and must actually be considered to be present in certain specific instances.

as when an identical twin or both parents are diabetic (77a).

If a patient was considered likely to be prediabetic, he/she was not used as a control in this investigation, as McMullen (94) reported that vascular pathology similar to that in diabetic patients may be present in prediabetics. This fact caused the loss of nine per cent of the control patients who presented for examination.

Each diabetic patient was paired with a "healthy" non-diabetic patient of the same age, the same sex, who lived in a suburb of similar rating, had an occupation of similar rating, had a similar educational standard and was born in the same country. Other facts recorded for both the diabetic and non-diabetic patient were the frequency of tooth brushing, whether the patient smoked and if so how many cigarettes per day. These facts were recorded on charts, miniature samples of which are shown on Charts 1 and 2. Chart 1 represents the chart used for the diabetic patient and Chart 2 the chart used for the healthy non-diabetic control patient.

The recorded facts and their relation to periodontal disease will be discussed to show why those variables were recorded and kept constant where possible.

Oral Hygiene Index.

Ludavalgo and Harris [82], Parfitt [112], Schei and his co-workers [136] have shown a strong correlation between the severity of periodontal disease and oral hygiene; Russell [129] [130] [131], Greene [66] [68] and O'Leary [110] used oral hygiene indices to emphasise this point which was also confirmed by many other studies [5] [24] [50] [71] [88] [89] [90] [104] [105] [117] [140].

Greene and Vermillion's oral hygiene index which has previously been described is used in this study; it includes a debris score which Campbell [28] contended has the greatest correlation with periodontal disease, and a calculus index which Belting, Hinkler and Dummett [10] contend was the important causative factor in periodontal disease. It will be of interest to examine these two facts in this investigation.

Age.

Age shows as equally as strong correlation to periodontal disease as recorded for oral hygiene. Russell [129] [131], Sandler and Stahl [134] and many other researchers [21] [26] [55] [97] [98] have emphasised this point. This does not mean that age in itself is the cause of periodontal disease, but rather that periodontal

disease is a cumulative process, and it must be realised that it does not mean that older individuals are less resistant to periodontal disease than younger people.

The age group chosen for study in this investigation was twenty-five to forty-nine years of age. The reasons for choosing this group were:-

1. after fifty years of age the periodontal disease index may be influenced by the loss of the seriously periodontally involved tooth.
2. vascular changes occur in the greatest proportion around fifty years of age in the average individual [2a], and as Gordon [62] and Bondy [18] have stated vascular changes take place some ten to thirteen years earlier in diabetes, the investigator considered that this group would be included if the thirty to thirty-nine age group was studied, and that if a twenty-five to twenty-nine age group was also studied the pre-vascular degeneration period of the diabetic could also be compared with the non-diabetic patient.

Sex.

In surveys carried out in the United States of

America and Europe, the periodontal condition in females was significantly better than in males (21) (89) (104) (127). Harris (71) has shown that in a less developed country this sex difference seems to be absent. As Australia must be considered on a developmental status equal to United States of America or Europe, it was considered necessary to pair diabetic and non-diabetic patients as regards sex to eliminate this possible variable.

Race.

Russell and Ayers (129) showed that race does not appear to cause any significant difference in the periodontal status, if education, dental care and oral hygiene were kept equal. Place of birth was recorded in this survey and kept equal in diabetic and non-diabetic patients, so that the socio-economic factor was more easily balanced.

Socio-economic and Educational Status.

People with a high income and education clean their tooth on an average better than those with a low income and education; this has been shown by surveys in which Lovdal, Arno and Waerhaug (89), Møbley and Smith (104) studied people with increased income and showed that they

have an improved periodontal status. Brandtzaeg and Jamison [24], Lovdal, Arno and Waerhaug [89], Hadley and Smith [104], Moore, Muhler and McDonald [105], Russell [68], Russell and Ayers [129], and Stahl and Morris [153] showed that as the years of education increased so the periodontal tissues improved.

The Socio-Economic Factor.

In this investigation the socio-economic factor was kept equal (or as near as possible) by the following method:

1. The suburb in which the patient lived was awarded a status number which was listed in Congalton's survey on the status rating of Sydney suburbs [36]. The diabetic patient was then paired with a non-diabetic patient living in a suburb of similar status rating.
2. The occupation of the patient was recorded and again awarded a number which was also listed by Congalton in another survey on the social status of occupations in Sydney [37], and the diabetic patient was paired with a non-diabetic patient with a similar occupational rating.
3. The educational factor was assessed as low if a patient had no secondary education; inter-

mediate if the patient had received part or full secondary education; and high if a patient had received a tertiary education - this record proved to be unnecessary, as all patients examined were in the intermediate category, perhaps this was because they were patients attending a public hospital and the non-executive staff of the hospital.

Matching suburbs of similar status and occupations of similar status and considering the other controlled variables caused a rejection of twenty per cent of the control patients presenting for examination.

Frequency of Tooth Brushing.

Stammeyer (154a) after studying over three thousand young adults observed that the gingival condition varied according to the frequency of tooth brushing. On the other hand, Brandtzaeg and Jamison (24a) reported that periodontal health and oral hygiene were not significantly related to frequency of the tooth brushing at the initial examination of their patients, however they did show that both periodontal health and oral hygiene improved after instruction in an efficient tooth brush technique. Belting, Hinkler and Dunnett (10) in their survey showed

that tooth brushing had tendency to decrease the severity of periodontal disease even though the decrease was not statistically significant. It will be interesting to compare tooth brushing and oral hygiene.

Smoking.

Frandsen and Findborg [54] stated that there is a high prevalence of ulcerated gingivitis in young cigarette smokers. Arno and co-workers [4], Brandtzaeg and Jamison [24], Frandsen and Findborg [54] and Findborg [115] reported that gingivitis as well as periodontitis increased with an increased use of tobacco. Findborg [115] stated "solely by means of statistical data, it has been shown that tobacco has an effect, per se, on the gingival tissues". However, Arno, Schlei, Lovdal and Vaerhaug [4], Brandtzaeg and Jamison [24a] contended that when the oral hygiene is good, the effect of tobacco was considerably reduced. One must consider that smoking may reflect that here is a very worried or deeply disturbed individual and so this fact is worth recording, for it may show some correlation between smoking and oral hygiene.

The Time of Examination.

The time of examination was recorded in this survey,

for this must have an effect on the debris score especially where a patient does not brush his/her tooth after lunch.

The significance of the survey results were determined by use of the following tests:-

1. The Student "t" Test (t).

The formula and method of determining the "t" test used in this survey was that described by Bradford-Hill [82] and are as follows:-

$$\text{Standard Deviation (S.D.)} = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N-1}}$$

$$\text{Standard Error (S.E.)} = \frac{S.D.}{\sqrt{N}}$$

The "t" test is then derived by the next three steps:

1. Find the difference between the mean scores.
2. Find the square root of the sum of :- the standard error of the diabetics squared plus the standard error of the non-diabetic group squared.
3. To determine the value of "t", the results of step one were divided by the results of step two.

The probability of the "t" value can then be determined by use of the student "t" table [84], the number of values or degrees of freedom is N-2.

2. The Correlation Coefficient (r).

Moroney's (55) gave the following formulas for determining the correlation coefficient (r), and for testing the significance of the correlation.

The Correlation Coefficient (r)

$$\text{Covariance} \begin{pmatrix}\text{Cov}\\ xy\end{pmatrix} = \frac{1}{N-1}\left(\Sigma xy - \frac{\Sigma x \Sigma y}{N}\right)$$

$\left(\Sigma = \text{Sum of}\right)$

$$\text{Variance} \begin{pmatrix}\text{Var}\\ x\end{pmatrix} \text{ or } x = \frac{1}{N-1}\left(\Sigma x^2 - \frac{(\Sigma x)^2}{N}\right)$$

$$\text{Variance} \begin{pmatrix}\text{Var}\\ y\end{pmatrix} \text{ or } y = \frac{1}{N-1}\left(\Sigma y^2 - \frac{(\Sigma y)^2}{N}\right)$$

$$\text{Correlation of coefficient} = \frac{\text{Cov } xy}{\sqrt{\text{Var. } x \text{ Var. } y}}$$

The correlation coefficient is then tested against zero by calculating "t" from the following formula:-

$$\frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

The degrees of freedom of t are N-2.

Although there is no generally accepted method of interpreting the size of r, the following is a possible method:-

less than .2 no correlation,

.2 - .4 low correlation (there is some present but it is weak),

.4 - .7 moderate,

.7 - .9 definite correlation, marked relationship,

.9 - 1 high correlation, very strong relationship. (51)

3. The Chi squared test (x^2).

The formula for x^2 is as follows:-

$$x^2 = \frac{(O - E)}{E}^2$$

O = observed figure

E = expected figure

The result is then transferred to a P value by using the x^2 table (84).

The results in these tests were considered significant when P was .001 or less than .001.

Diabetic

	Right	Ant.	Left	Total
Upper	B / L			
Lower	B / L			
Total	B / L			

B - buccal
L - lingual

Debris Index:

	Right	Ant.	Left	Total
Upper	B / L			
Lower	B / L			
Total	B / L			

B - buccal
L - lingual

Calculus Index:

Oral Hygiene Index:

Russell Index

	Right								Left								Total
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
Upper																	
Lower																	

Russell Periodontal Index:

Retinopathy Yes ☐ No ☐

Arteriosclerosis Yes ☐ No ☐

Smoking:

Name

Date
Time
Name
Age Sex
Suburb
Occupation
Ed.Assessment
Nation of birth
Period diabetic

Manner of diabetic control
Diet ☐
Tablets ☐☐
Insulin ☐☐
30/u. insulin ☐

State of diabetic control
Poor ☐
Fair ☐☐
Good ☐

T/D frequency
1 daily ☐
2 daily ☐☐
3 daily ☐☐

Non-Diabetic Control

	Right	Ant.	Left	Total
Upper	B / L			
Lower	B / L			
Total	B / L			

B - buccal
L - lingual

Debris Index:

	Right	Ant.	Left	Total
Upper	B / L			
Lower	B / L			
Total	B / L			

B - buccal
L - lingual

Calculus Index:

Oral Hygiene Index:

Russell Index

	Right								Left								Total
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
Upper																	
Lower																	

Russell Periodontal Index:

Smoking:

Date
Time
Name
Age Sex
Suburb
Occupation
Ed.Assessment
Nation of birth
Family History of Diabetes — Mother, Father, Relative
Medical History
T/B frequency
1 daily ☐
2 daily ☐
3 daily ☐

B. RESULTS

To determine the number of patients required for this survey, a pilot study was carried out on the first thirty-two diabetic patients and their respective control patients. The diabetic patients were told by their attending physician to come for a periodontal examination; the non-diabetic patients were told to come for a periodontal examination by the attending physician or by the head of their department.

The number of patients in each age group, the respective mean Russell periodontal index (R.P.I.), the standard deviation (S.D.), and the standard error (S.E.) for the diabetic and non-diabetic group for this pilot study are shown in TABLE 1.

TABLE 1.

		Diabetic			Non-Diabetic		
Age Group	No. of patients	R.P.I.	S.D.	S.E.	R.P.I.	S.D.	S.E.
25-29	9	2.27	.90	.30	0.80	.36	.12
30-39	6	2.66	1.09	.44	1.83	1.85	.44
40-49	17	3.75	.44	.11	2.42	.65	.16
Total Group							
25-49	32	3.13	.93	.16	1.85	.96	.17

Shown on Figure 1.

To test whether there was any significant difference

in the Russell periodontal index, the student "t" was used.

The "t" value for the 25-29 year age group was 4.59 ($P < 0.001$) showing there to be a significant difference in this age group. In the 30-39 year age group the "t" value was 1.34 ($P < 0.30$ and > 0.20) which showed no significance. In the 40-49 year age group "t" had a value of 7.00 ($P < 0.001$) showing here again a definite significant difference in the diabetic and non-diabetic groups. The total group gave a "t" value of 4.22 ($P < 0.001$) showing a significant difference.

Considering the results of this pilot study, it was decided to increase the 25-29 and the 40-49 years age groups and to double or treble the 30-39 year age group.

The results of the survey are shown in detail in the Reference Tables II - VII; all tables and statistical results have been derived from these tables.

The Russell Periodontal Index.

Russell periodontal index scores for diabetic and non-diabetic groups (by age) are presented on tables VIII and IX and figures IV, VII and X.

The mean Russell periodontal index for the diabetics and non diabetics showed a greater score in the diabetics for all sub groups and for the total group. The "t" test

showed the difference in all subgroups and in the total group was significant ($P < .001$).

The Russell Periodontal Index.

TABLE VIII.

DIABETICS

Age Group	No. Patients	R.P.I.	S.D.	S.E.
25-29	15	2.10	.88	.23
30-39	19	2.81	.74	.17
40-49	33	3.72	1.13	.19
Total group				
25-49	67	3.10	1.17	.14

Shown on the left of Figures II, V and VIII.

TABLE IX.

NON-DIABETICS Russell Periodontal Index.

Age Group	No. Patients	Mean R.P.I.	S.D.	S.E.
25-29	15	0.85	.37	.10
30-39	19	1.67	.78	.18
40-49	33	2.39	.72	.13
Total Group				
25-49	67	1.84	.88	.11

Shown on left of Figures III, VI and IX.

The correlation coefficient between age, debris, calculus, oral hygiene and the periodontal Index was determined.

Age.

The mean age and the mean Russell periodontal scores

are presented on Table X and Figures IV, VII and X.

The correlation between age and the Russell periodontal index -

in the diabetic group is .6693, t = 6.1952

($P < .001$)

in the non-diabetic group is .6773, t = 7.4221

($P < .001$)

These figures show significant correlation of moderate strength between age and Russell periodontal index in both diabetic and non-diabetic groups.

TABLE X.

Age and Russell periodontal index in Diabetics and Non-Diabetics.

	Mean age	S.D.	S.E.	Mean R.P.I.	S.D.	S.E.
Diabetic	38.25	8.23	1.01	3.10	1.18	0.14
Non-Diabetic	38.25	8.23	1.01	1.84	0.91	0.11

The Debris Score.

The mean debris score and the mean Russell periodontal index are presented on Tables XI and XII, and on Figures II and III.

The correlation coefficient of the debris score to the Russell periodontal index was of no significance in either group.

Debris.

TABLE XI.

DIABETICS Mean debris index - mean R.P.I.

Age Group	No. of Patients	Debris	S.D.	S.E.	R.P.I.	S.D.	S.E.
25-29	15	2.52	.44	.10	2.10	.89	.23
30-39	19	2.11	.88	.20	2.81	.74	.17
40-49	33	2.08	.59	.10	3.72	1.13	.19
Total Group							
25-49	67	2.17	.87	.11	3.10	1.17	.14

TABLE XII.

NON-DIABETIC Mean Debris index - mean R.P.I.

Age Group	No. of Patients	Debris	S.D.	S.E.	R.P.I.	S.D.	S.E.
25-29	15	1.31	.66	.17	0.85	.37	.10
30-39	19	1.70	.76	.17	1.67	.78	.18
40-49	33	1.83	.64	.11	2.39	.72	.13
Total Group							
25-49	67	1.61	.72	.09	1.84	.88	.11

The Calculus Score.

The mean calculus scores and the mean Russell periodontal index scores for the diabetic and non-diabetic groups are presented on Tables XIII and XIV and Figures V and VI.

The correlation coefficient of the calculus index to the Russell periodontal index -

in the diabetic group is .7302, t = 13.0987

($P < .001$)

in the non-diabetic group is .7908, t = 10.01

($P < .001$)

showing that both the diabetic and non-diabetic groups have a highly significant and moderately strong correlation between calculus scores and the Russell periodontal index scores.

Calculus.

TABLE XIII.

DIABETICS Mean Calculus Index - mean R.P.I.

Age Group	No. of Patients	Calculus	S.D.	S.E.	R.P.I.	S.D.	S.E.
25-29	15	2.04	.44	.10	2.10	.89	.23
30-39	19	2.19	.95	.22	2.81	.74	.17
40-49	33	2.91	1.21	.21	3.72	1.13	.19
Total Group							
25-49	67	2.35	1.14	.14	3.10	1.17	.14

TABLE XIV.

NON-DIABETIC Mean calculus index - mean R.P.I.

Age Group	No.of Patients	Calculus	S.D.	S.E.	R.P.I.	S.D.	S.E.
25-29	15	0.59	.62	.16	0.85	.37	.10
30-39	19	1.52	1.34	.31	1.67	.78	.18
40-49	33	1.98	.76	.13	2.39	.72	.13
Total Group							
25-49	67	1.36	1.10	.13	1.84	.88	.11

Oral Hygiene Index.

The mean oral hygiene index scores and the mean Russell periodontal index scores for diabetics and non-diabetics are presented in age groups on Tables XV and XVI and Figures VIII and IX.

The correlation coefficient between the oral hygiene index and the Russell periodontal index -

in the diabetic group is .5786, t = 4.1086

($P < .001$)

in the non-diabetic group is .6891, t= 7.6579

($P < .001$)

so that there is a highly significant correlation of moderate strength between oral hygiene and Russell periodontal index in both the diabetic and non-diabetic groups.

Oral Hygiene.

TABLE XV.

DIABETICS

Age Group	No.of Patients	Mean oral hygiene index	S.D.	S.E.	Mean R.P.I.	S.D.	S.E.
		Mean Oral Hygiene Index			Mean Russell periodontal index		
25-29	15	4.53	1.96	.51	2.10	.89	.23
30-39	19	4.31	.16	.46	2.81	.74	.17
40-49	33	4.91	2.50	.47	3.71	1.13	.19
Total Group							
25-49	67	4.52	2.12	.26	3.10	1.17	.14

TABLE XVI.

NON-DIABETIC

Age Group	No.of Patients	Mean oral hygiene index	S.D.	S.E.	Mean R.P.I.	S.D.	S.E.
		Mean Oral Hygiene Index			Mean Russell periodontal index		
25-29	15	1.90	1.92	.50	0.85	.37	.10
30-39	19	3.27	1.97	.45	1.67	.78	.18
40-49	33	3.91	.65	.11	2.30	.72	.13
Total Group							
25-49	67	3.03	.90	.11	1.84	.88	.11

To test the significance of other known variables the X^2 test was used.

The Period of Diabetes.

The mean Russell periodontal index scores of patients known to be diabetic up to but not including the fifth year, those known to be diabetic for five years or more and the total diabetic group are presented on Table XVII and Figure XI.

The results show a small difference in the mean periodontal index, being slightly higher in the over five years period. The X^2 test showed the difference was not significant.

Period of Diabetes.

TABLE XVII.

Period of diabetes	No. of Patients	Mean R.P.I.	S.D.	S.E.
0-4 years	22	2.90	1.35	.32
5 years and over	45	3.15	1.12	.17
Total group	67	3.10	1.17	.14

Manner of Diabetic Treatment.

The manner of diabetic treatment with the respective mean Russell periodontal index scores is shown on Table XVIII and Figures XII and XIII.

The insulin treated patients showed a lower mean Russell periodontal index than patients treated with tablets or diet. The group treated with over thirty units of insulin showed a lower mean periodontal score than the patients under any other treatment, including smaller amounts of insulin, diet or tablets. These figures, however, are influenced by the greater portion of under thirty year old patients (80%) being treated with over 30 units of insulin.

The X^2 test showed that these differences were of no significance.

TABLE XVIII.

Manner of diabetic treatment.

Manner of treatment	No. of Patients	Mean R.P.I.	S.D.	S.E.
Diet	6	4.07	.38	.16
Tablets	7	3.09	.56	.20
Insulin	10	2.93	.37	.12
Over 30/u insulin	44	3.05	1.28	.20

Insulin treated - Non-insulin treated

Treatment	No. of Patients	Mean R.P.I.	S.D.	S.E.
Non-insulin Group	13	3.58	.59	.16
Insulin Group	54	2.99	1.26	.17

Over 30/u of insulin - all other treatment

Treatment	No. of Patients	Mean R.P.I.	S.D.	S.E.
All other treatment	23	3.37	.94	.19
Over 30/u insulin	44	3.05	1.28	.20

The State of Diabetic Control.

The state of diabetic control with respective mean Russell periodontal index scores is shown on Table XIX and Figure XIV.

In all the diabetic subgroups (according to age) and in the total group the well controlled patients showed a lower mean Russell periodontal index score, however the X^2 test showed these differences were not significant.

State of Diabetic Control.

TABLE XIX.

State of Diabetic Control.

Age Group	No. of Patients	State of Control	Mean of R.P.I.	S.D.	S.E.
25-29	11	poor or fair	2.62	.73	.22
30-39	12	poor or fair	2.81	.51	.15
40-49	27	poor or fair	4.77	1.23	.24
Total Group					
25-49	50	poor or fair	3.40	1.13	.16
25-29	4	good	1.32	.90	.45
30-39	7	good	2.49	.97	.37
40-49	6	good	3.61	.69	.28
Total Group					
25-49	17	good	2.37	1.20	.29

Missing Teeth.

Ramfjord (117) in his study showed that lower incisors, first molars and bicuspids are the most likely teeth to be the indicators of the periodontal condition. Considering this fact it was necessary to make sure that the loss of these teeth had not significantly influenced the results in this survey.

Only two patients had missing lower anteriors; one patient had lost four lower incisors, the other three, both patients were diabetics.

If these teeth had not been lost and had registered a high periodontal score, the effect would have been to increase the mean periodontal score in the diabetics by a very small degree, if on the other hand the periodontal score had been negative for all these teeth the change in the mean score would have been of even less significance. Therefore the loss of these teeth was not considered in the calculations.

The total number of missing teeth, the missing lower incisors, the missing first molars and the missing bicuspids are shown on Table XX and on Figures XV, XVI and XVII.

When the X^2 test was used for these figures the "P" value was of no significance.

Missing Teeth.

TABLE XX.

	Diabetics	Mean	Non-diabetics	Mean
Missing teeth	770	11.5	631	9.4
Missing lower incisors	7	.1	0	0
Missing first molars	145	2.2	108	1.6
Missing bicuspids	172	2.5	136	2.0

Sex.

The mean Russell periodontal index scores for all age subgroups and the total group of diabetic and non-diabetic male and female patients are shown on Table XXI and XXII and Figure XVIII.

Sex.

TABLE XXI.

DIABETICS

	MALE				FEMALE			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.I.	S.D.	S.E.
25-29	1	3.27	0	0	14	2.02	.86	.23
30-39	5	3.13	.91	.41	14	2.70	.66	.18
40-49	14	3.91	.96	.26	19	3.43	1.13	.23
Total Diabetic Group								
25-49	20	3.44	1.02	.23	47	2.72	1.09	.16

TABLE XXII.

NON DIABETICS

	MALE				FEMALE			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.I.	S.D.	S.E.
25-29	1	1.07	0	0	14	2.02	.40	.11
30-39	5	2.04	.49	.22	14	1.53	.79	.21
40-49	14	2.46	.82	.22	19	2.22	.95	.22
Total non-diabetic group								
25-49	20	1.86	.78	.18	47	1.51	.93	.14

Tooth Brushing Frequency.

Toothbrushing frequency was divided into two groups; once or less per day and twice or more per day, and the respective mean Russell periodontal index was recorded. These figures are shown in Table XXII and Figures XIX and XX.

The X^2 test showed these differences were not significant.

Toothbrushing Frequency.

Toothbrushing Frequency - Russell Periodontal Index.

TABLE XXIII.

DIABETICS

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.O.	S.D.	S.E.
25-29	7	2.49	.72	.27	8	1.76	.92	.32
30-39	11	3.06	.97	.29	8	2.47	.42	.15
40-49	14	3.94	.89	.25	19	3.60	1.53	.38
Total diabetic group								
25-49	32	3.16	.82	.15	35	2.61	1.43	.24

NON-DIABETIC

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.O.	S.D.	S.E.
25-29	1	1.28	0	0	14	0.82	.35	.10
30-39	4	2.15	.74	.38	15	1.53	.73	.19
40-49	11	2.93	.56	.17	22	2.46	.72	.15
Total non-diabetic group								
25-49	16	2.12	.69	.17	51	1.60	.81	.11

Toothbrushing frequency was again divided into the two same groups and the mean debris scores recorded for those groups. Those figures are shown on Table XXIV and XXV and on Figures XXI and XXII.

The X^2 test showed the differences in the mean debris scores were not significant in any of the groups.

Toothbrushing frequency - Debris index.

TABLE XXIV.

DIABETICS

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean Debris I.	S.D.	S.E.	No. of Patients	Mean Debris I.	S.D.	S.E.
25-29	7	2.55	.96	.36	8	1.28	1.21	.43
30-39	11	2.44	.97	.29	8	1.67	.51	.18
40-49	14	2.55	.48	.13	19	1.82	.59	.14
Total Diabetic Group								
25-49	32	2.51	1.04	.18	35	1.59	.79	.13

TABLE XXV.

NON DIABETIC

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean Debris I.	S.D.	S.E.	No. of Patients	Mean Debris I.	S.D.	S.E.
25-29	1	2.17	0	0	14	1.25	.63	.17
30-39	4	2.15	1.14	.57	15	1.53	.99	.23
40-49	11	2.20	.43	.13	22	1.95	.90	.17
Total non-diabetic group								
25-49	16	2.17	.35	.09	51	1.58	.74	.10

Toothbrushing frequency was recorded in the same two groups (once or less, twice or more) and the mean calculus scores recorded for diabetic and non-diabetic groups. These figures are shown on Tables XXVI and XXVII and represented on Figures XXIII and XXIV. The X^2 test showed the differences were not significant.

Toothbrushing frequency - Calculus Index.

TABLE XXVI.

DIABETICS

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean calculus I.	S.D.	S.E.	No. of Patients	Mean calculus I.	S.D.	S.E.
25-29	7	2.62	1.27	.48	8	1.62	1.02	.36
30-39	11	2.65	.99	.67	8	1.56	.61	.22
40-49	14	3.29	1.14	.31	19	2.52	.97	.22
Total diabetic group								
25-49	32	2.52	1.13	.20	35	1.57	1.02	.17

TABLE XXVII.

NON-DIABETIC

	1/less toothbrushing				2/more toothbrushing			
Age Group	No. of Patients	Mean calculus I.	S.D.	S.E.	No. of Patients	Mean calculus I.	S.D.	S.E.
25-29	1	1.00	0.	0	14	0.56	.63	.17
30-39	4	2.54	1.22	.61	15	1.31	1.20	.31
40-49	11	2.39	.68	.21	22	1.78	.91	.20
Total non-diabetic group								
25-49	16	1.98	.87	.22	51	1.31	1.04	.15

Time of Examination.

The mean debris scores were recorded for patients in all subgroups and the total groups (according to age) and the time of examination was divided into A.M. and P.M. The scores for these groups are recorded on Tables XXVIII and XXVIX and represented on Figure XXV. The X^2 test showed there was no siguificant difference in the debris score when time of examination was used to give two groups of patients (A.M. and P.M.)

Time of Examination

Time of examination - Debris index.

TABLE XXVIII.

DIABETICS

	A.M.				P.M.			
Age Group	No. of Patients	Debris I.	S.D.	S.E.	No. of Patients	Debris I.	S.D.	S.E.
25-29	6	3.19	1.03	.42	9	2.02	.83	.28
30-39	7	1.90	.96	.36	12	2.22	.85	.31
40-49	14	1.92	.62	.17	19	2.17	.86	.20
Total group								
25-49	27	2.34	.97	.19	40	2.14	.83	.13

TABLE XXIX.

NON-DIABETIC

	A.M.				P.M.			
Age Group	No. of Patients	Debris I.	S.D.	S.E.	No. of Patients	Debris I.	S.D.	S.E.
25-29	10	1.27	.64	.20	5	2.50	.54	.24
30-39	14	1.59	.71	.18	5	2.12	1.06	.53
40-49	15	1.77	.70	.18	18	1.88	.61	.14
Total Group								
25-49	39	1.54	.68	.11	28	2.28	.50	.10

Smoking.

The mean Russell periodontal scoresfor smokers and non-smokers when divided into subgroups (by age) are presented on Tables XXX and XXXa and Figure XXVI.

The X^2 test shows that there is no significant difference between smokers and non-smokers in the groups examined.

Smoking.

TABLE XXX.

DIABETICS

	SMOKERS				NON-SMOKERS			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.I.	S.D.	S.E.
25-29	7	2.07	.99	.35	8	2.73	.81	.31
30-39	11	3.16	.69	.24	8	1.65	.69	.21
40-49	19	3.72	1.17	.31	14	3.72	.99	.23
Total diabetic group								
25-49	37	3.32	1.17	.22	30	2.70	1.17	.19

TABLE XXXa.

NON-DIABETICS

	SMOKERS				NON-SMOKERS			
Age Group	No. of Patients	Mean R.P.I.	S.D.	S.E.	No. of Patients	Mean R.P.I.	S.D.	S.E.
25-29	11	0.87	.38	.19	4	0.84	.13	.04
30-39	15	1.82	.93	.47	4	1.63	.80	.21
40-49	21	2.54	.74	.21	12	2.32	.72	.16
Total non-diabetic group								
25-49	47	1.74	.97	.22	20	1.59	.90	.13

The results of the survey were now programmed for a computer, the variables are listed:

1. Diabetes = 1 Non-diabetic control = 0
2. Age
3. Sex Male = 1 Female = 0
4. A.M. = 1 P.M. = 0
5. Tooth brushing 2/more = 1 1/less = 0
6. Smoking Yes = 1 No = 0
7. Period of diabetes
8. Manner of Control Over 30/u insulin = 1
   all other treatment = 0
9. State of control Good = 1 Fair or poor = 0
10. Debris index
11. Calculus index
12. Hygiene index
13. Russell periodontal index

For the non-diabetic control patients there are no entries for variables 7, 8 and 9.*

* Since blanks on an I.B.M. card are read as zeros, it follows that the control patients are regarded by the program as having diabetes for 0 years, being in poor or fair control and the method of treatment is without 30/units of insulin. Therefore when analysing the 134 observations, all correlations with variables 7, 8 and 9 must be ignored. When analysing the 67 diabetics, this, of course, does not apply.

TABLE XXXb.

Correlations on the 134 patients.

Diabetes	vs.	Russell periodontal index	0.5244
Age	vs	Russell periodontal index	0.5361
Debris I.	vs	Calculus I	0.6959
Debris I.	vs	Hygiene I (must be expected because debris I = hygiene I + calculus I)	0.8828
Debris I.	vs	Russell periodontal index	0.5402
Calculus I.	vs	Hygiene I. (again expected because of above formula)	0.9484
Calculus I.	vs	Russell periodontal index	0.8249
Hygiene I.	vs	Russell periodontal index	0.8249
Diabetes	vs	Debris I.	0.3007
Diabetes	vs	Calculus I.	0.3835
Diabetes	vs	Hygiene I.	0.3762
Age	vs	Calculus I.	0.3877
	Age vs debris shows no correlation.		
Sex	vs	Russell periodontal index	0.3405
Tooth brushing	vs	Debris I.	-0.3863
" "	vs	Calculus I.	-0.4537
" "	vs	Hygiene I.	-0.4514
" "	vs	Russell periodontal index	-0.3861

Full details shown on reference Table XXXIX.

TABLE XXXI.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Diabetes	0.50	0.50	0.5244	8.4501	< 0.001
Age	38.25	8.20	0.53612	7.9941	< 0.001
Sex	0.299	0.46	0.34047	3.34742	< 0.005
AM/PM	0.485	0.50	-0.21817	-1.17616	< 0.30
Tooth Brushing	0.634	0.48	-0.38606	-3.08253	< 0.005
Smoking	0.373	0.49	0.14948	0.8526	< 0.40

The regression of Russell periodontal index on the above variables shows a significant correlation with diabetes, age and sex. There is a strong negative correlation with tooth brushing frequency, but no significant correlation with time of examination or smoking.

TABLE XXXII.

Regression of

Hygiene index on

VARIABLES	MEAN	S.D.	r	t	P
Diabetes	0.50	0.50	0.37621	3.48859	< 0.001
Age	38.25	8.20	0.28250	2.72775	< 0.01
Sex	0.299	0.46	0.18221	1.02016	< 0.30
AM/PM	0.485	0.50	-0.22705	-1.55248	< 0.20
Tooth Brushing	0.634	0.48	-0.45136	-4.24261	< 0.001
Smoking	0.373	0.48	0.17491	0.89101	< 0.40

The regression of the hygiene index on the above variables shows a significant correlation with diabetes and a significant negative correlation with tooth brushing, a low significant correlation with age and no significant correlation with sex, time of examination or smoking.

TABLE XXXIII.

Regression of

Calculus on

VARIABLES	MEAN	S.D.	r	t	P
Diabetes	0.50	0.50	0.64413	3.80587	< .001
Age	38.25	8.20	0.53612	7.9941	< .001
Sex	0.299	0.46	0.34047	3.34742	< .005
AM/PM	0.485	0.50	-0.21817	-1.17616	< .05
Tooth Brushing	0.634	0.48	-0.38606	-3.08253	< .005
Smoking	0.373	0.49	0.14948	0.8526	< .04

Calculus shows a significant correlation with diabetes and age, a significant negative correlation with tooth-brushing frequenty and no correlation of any significance with sex, time of examination or smoking.

TABLE XXXIV.

Regression of

Debris index on

VARIABLES	MEAN	S.D.	r	t	P
Diabetes	0.50	0.50	0.30075	2.42132	<.05 >.025
Age	38.25	8.20	0.08255	0.21068	<.90 >.80
Sex	0.299	0.459	0.9672	0.65877	<.60 >.50
AM/PM	0.485	0.501	-0.15046	-0.80244	<.50 >.40
Tooth Brushing	0.634	0.48	-0.38627	-3.70201	<.001
Smoking	0.373	0.49	0.12441	0.43463	<.70 >.60

The debris index shows a significant negative correlation with tooth brushing frequency, some correlation with diabetes and a correlation of no significance with age, sex, time of examination or smoking.

TABLE XXXV.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Diabetes	0.50	0.50	0.52444	7.49144	< .001
Age	38.25	8.20	0.53612	6.41241	< .001
Sex	0.298	0.46	0.34047	3.49296	< .005
AM/PM	0.485	0.50	-0.21817	0.29171	< .80
Tooth Brushing	0.634	0.48	-0.38606	0.36000	< .80
Smoking	0.373	0.49	0.14948	-1.15101	< .30
Debris	1.93	0.80	0.54019	0.56469	< .60
Calculus	2.02	1.20	0.82492	8.68867	< .001

The periodontal index shows a significant correlation with diabetes, age and calculus, a smaller but still significant correlation with sex. There was no significant correlation with toothbrushing, time of examination, smoking or debris index.

The next observations are of sixty-seven diabetic patients only.

Full details of the next table are shown on reference Table XXXVI.

TABLE XXXVII.

Age	vs	Russell periodontal index	0.5979
Debris I.	vs	Calculus I.	0.6113
Debris I.	vs.	Hygiene I.	0.8642
Calculus I.	vs	Hygiene	0.9228
Calculus I.	vs	Russell periodontal index	0.7560
Hygiene I.	vs	Russell periodontal index	0.7560
Age	vs	Manner of control	0.3769
Age	vs	Calculus I.	0.3493
Sex	vs	Russell periodontal index	0.4524
AM/PM	vs	Manner of control	-0.3382
Tooth Brushing	vs	Debris I.	-0.3324
"	vs	Calculus I.	-0.4155
"	vs	Hygiene I.	-0.4135
State of control	vs	Calculus I.	-0.3446
"	vs.	Hygiene I.	-0.3605

Full details in reference Table XXXVI.

TABLE XXXVIII.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	0.59793	4.97366	$< .001$
Sex	0.299	0.46	0.45242	2.97226	$< .70$
AM/PM	0.403	0.49	0.00624	0.72062	$< .50$
Tooth Brushing	0.507	0.50	-0.19626	-1.39570	$< .20$

TABLE XXXVIII. (continued)

VARIABLES	MEAN	S.D.	r	t	P
Smoking	0.448	0.50	-0.25000	0.80781	< .50
Period of Diabetes	9.162	7.75	-0.02475	1.08329	< .30
Manner of control	0.641	0.48	-0.14104	0.57937	< .60
State of control	0.253	0.44	-0.25224	-1.24893	< .30

Russell periodontal index shows a significant correlation with age in the diabetic patient, and no correlation of any significance with sex, time of examination, tooth-brushing, smoking, period of, manner of control of or state of control of diabetes.

TABLE XXXIX.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	0.59793	3.92435	< .001
Sex	0.29	0.46	0.45242	2.71491	< .01
AM/PM	0.40	0.49	0.00624	0.01595	< .99
Tooth Brushing	0.51	0.50	-0.19626	1.17894	< .30
Smoking	0.45	0.50	0.02500	-0.95497	< .40
Debris	2.17	0.84	0.34443	-0.73887	< .50
Calculus	2.48	1.13	0.75598	0.22202	< .90
Hygiene	4.67	1.17	0.64540	0.78081	< .50

Russell periodontal index shows a significant correlation with age and a smaller but still significant

correlation with sex. There was no correlation of any significance with time of examination, toothbrushing, smoking, or with the debris, calculus or hygiene index. The lack of correlation with calculus would be influenced by the oral hygiene index (which is an addition of the debris and calculus index) taking out any significance there may be for these two indexes.

TABLE XXXX.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	0.59793	3.67363	< .001
Sex	0.30	0.46	0.45242	2.65253	< .01
AM/PM	0.41	0.49	0.00624	0.18336	< .90
Tooth Brushing	0.51	0.50	-0.19626	-1.11779	< .30
Smoking	0.45	0.50	0.02500	0.98882	< .40
Period of Diabetes	9.16	7.75	-0.02475	-0.78577	< .50
Manner of control	0.64	0.48	-0.14104	-0.04104	< .975
State of control	0.25	0.49	-0.25224	0.35308	< .50
Debris	2.17	0.85	0.34442	0.01411	< .99
Calculus	2.48	1.13	0.75598	5.90075	< .001

Russell periodontal index shows a significant correlation with age and calculus, a smaller but still very

significant correlation with sex. There was no significant correlation with time of examination, toothbrushing, smoking, debris index or period of, manner of control of or state of control of diabetes.

TABLE XXXXI.

Regression of

Russell periodontal index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	0.59793	3.65268	< .001
Sex	0.30	0.46	0.45242	2.71331	< .01
AM/PM	0.41	0.49	0.00624	0.03078	< .98
Tooth brushing	0.51	0.50	-0.19626	-1.02190	< .40
Smoking	0.45	0.50	0.02500	0.87797	< .40
Period of diabetes	9.16	7.75	-0.02475	0.88147	< .40
Manner of control	0.64	0.48	-0.14104	-0.16778	< .90
State of control	0.25	0.44	-0.25224	0.42409	< .70
Debris	2.17	0.85	0.34442	-0.67535	< .40
Calculus	2.48	1.14	0.75598	0.09131	< .95
Hygiene	4.67	1.79	0.64540	0.89557	< .40

The Russell periodontal index shows a significant correlation with age and a correlation of slightly less significance with sex in the diabetic patient when all

recorded facts are used. There was no significant correlation with any of the other variables.

TABLE XXXXII.

Regression of

Hygiene Index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	0.16754	1.28489	< .30
Sex	0.29	0.46	0.21945	1.32279	< .20
AM/PM	0.40	0.49	0.00285	1.35051	< .20
Tooth Brushing	0.51	0.50	-0.41354	-3.20818	< .005
Smoking	0.45	0.50	0.19278	1.95103	< .10
Period of diabetes	9.16	7.74	0.08734	1.22781	< .30
Manner of control	0.64	0.48	0.04923	1.09730	< .30
State of control	0.25	0.44	-0.36053	-2.4793	< .02

The hygiene index shows a significant negative correlation with toothbrushing frequency and a negative correlation of smaller significance with the state of control of diabetes. There was no significant correlation with sex, time of examination, smoking, period of diabetes or manner of control of diabetes.

TABLE XXXXIII.

Regression of

Calculus index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.25	0.34935	2.77418	< .01
Sex	0.30	0.46	0.27924	1.44383	< .20
AM/PM	0.40	0.49	-0.03187	-0.83250	< .50
Tooth brushing	0.50	0.50	-0.41554	-3.25397	< .005
Smoking	0.45	0.50	0.20379	2.21898	< .05
Period of diabetes	9.16	7.74	-0.00737	0.70724	< .50
Manner of control	0.64	0.48	-0.03476	0.86842	< .40
State of control	0.25	0.44	-0.34456	-2.16310	< .05

The calculus index shows a significant negative correlation with toothbrushing and a positive correlation of significance with age, a correlation of some significance with smoking and a negative correlation of some significance with state of diabetic control. There was no correlation of any significance with sex, time of examination, period of diabetes or manner of control.

TABLE XXXXIV.

Regression of

Debris index on

VARIABLES	MEAN	S.D.	r	t	P
Age	38.25	8.23	-0.11090	-0.80618	< .50
Sex	0.29	0.46	0.09987	0.98375	< .40
AM/PM	0.40	0.49	0.02512	1.45242	< .20
Tooth brushing	0.50	0.50	-0.33238	-2.56136	< .05
Period of diabetes	9.16	7.74	0.20474	1.71671	< .10
Manner of control	0.64	0.48	0.13974	0.94515	< .40
State of control	0.25	0.44	-0.28951	-2.11041	< .05

Debris shows a mild significance of negative correlation with the state of control of diabetes and with toothbrushing frequency. There was no significant correlation with age, sex, time of examination, smoking, period of diabetes or manner of control.

The Russell periodontal index in the diabetic versus the non-diabetic control group: The mean periodontal index among the entire group of diabetic patients was significantly higher at the 0.001 level (using the "t" test) than in the non-diabetic group of patients, confirming the hypothesis that diabetes and periodontal disease are associated, this is shown in Tables VIII and IX. Within each age group, the 25-29 year old group, the 30-39 year ago group and the 40-49 year age group, all showed a mean periodontal index which was significantly higher at the 0.001 level ("t" test)than in the non-diabetic control group in similar age groups.

The results of this survey showed a highly significant correlation at the 0.001 level between the Russell periodontal index and diabetes mellitus, this occurred in all selections shown in Tables XXXI and XXXV. The correlation was very significant at the 0.001 level between diabetes and the Russell periodontal index when the debris index, the calculus index and the oral hygiene index was withdrawn, this selection results are shown in Table XXXI.

Period of diabetes, manner of diabetic control and state of diabetic control showed no significant correlation with the Russell periodontal index, refer Tables

XXXVIII, XXXX and XXXXI, however the state of diabetic control has some negative correlation even though it is weak, with the calculus index, the debris and of course the oral hygiene index (Tables XXXXII, XXXXIII and XXXXIV). As the calculus index and the Russell periodontal index have a significant correlation, it therefore follows that the state of diabetic control has an eventual effect on periodontal disease, that is the well controlled diabetic patient would be expected to have a lower periodontal index.

The nature of the association between diabetes and periodontal disease was investigated further by examining the effect of the known variables recorded upon the periodontal index. In all selections on the computer, age and sex showed a very significant correlation with periodontal disease, but these two strong variables were controlled in this survey by pairing a diabetic with a non-diabetic of the same age and sex. The other variable which was kept constant in this survey was the socio-economic factor. The uncontrolled variables which will now be discussed are the time of examination, tooth brushing frequency, smoking, the debris index, the calculus index and the oral hygiene index.

The time of examination was recorded so that if there

was any great variation in the debris index, before and after eating the midday meal this fact would be noted and therefore not influence any conclusions drawn from this study. However there was no significant correlation between the debris index and the time of examination. There was a mild negative correlation with the calculus index (Table XXXIII), but this would be explained by the fact that 63% of the younger patients who have a lower calculus index (Table XIII and XIV) were examined at the Royal Prince Alfred hospital where the diabetic clinic is held in the afternoon, whereas the greater portion of the older patients who had a higher mean calculus index were examined at the Royal North Shore hospital where the diabetic clinic is held in the morning.

Toothbrushing frequency shows a significant negative correlation with the oral hygiene index (Table XXXII and XXXXII), with the calculus index (Table XXXIII and XXXXIII), and with the debris index (Table XXXIV and XXXXIV,) and as the calculus index has a very significant correlation with the Russell periodontal index (Table XXXV and XXXX,) toothbrushing must be considered a variable of some significance in this survey. Even though the non-diabetic group show more patients cleaning their teeth twice a day or more, than in the diabetic group of patients, this

variable would be indirectly removed when the calculus index was not included in the selection shown in Table XXXI.

Smoking showed a mild correlation with the calculus index, but as this variable was almost equal in the two groups, it would appear not to have affected the results in this survey.

The debris index shows a significant correlation with periodontal index in the non-diabetic group and a smaller significant correlation with the periodontal index in the diabetic group shown in Tables XI and XII. The results showed no correlation of any significance between the debris index and the Russell periodontal index in the 134 patients examined (Table XXXV) or in the diabetic group of patients (Table XXXX), however the calculus index being the stronger variable would have removed the effect of the debris index in these two selections.

The calculus index showed a significant correlation with the Russell periodontal index in all 134 patients examined (Table XXXX), in the diabetic group (Tables XII and XXXX), and in the non-diabetic group (Table XIV). The calculus index stands out as the variable having the greatest effect on the Russell periodontal index, and as the mean calculus score was much higher in the diabetic

group and all the diabetic subgroups than in the non-diabetics, this must be a strongfactor in the higher mean Russell periodontal index in the diabetic group.

Considering that the oral hygiene index is the sum of the debris index and the calculus index, it would be expected to show a significant correlation with the Russell periodontal inder, and this was the case in all groups of diabetics and non-diabetics (Tables XXXb and XXXVII).

The number of missing teeth was recorded and subdivided into the number of missing lower incisors, the the number of missing first molars and the number of missing bicuspids, however Table XX shows that this factor has no significant effect on the results in this survey.

C. DISCUSSION.

"The problem of interpretation is always more difficult to deal with than the statistical manipulations, and for this side of the work there is no substitute for detailed practical acquaintance with every aspect of the problem" (85). Therefore one must be wary of drawing definite conclusions, when it is realised that there are so many unknown factors in the aetiology of periodontal disease, diabetes mellitus and in the psychological make-up of the individual patients concerned.

The facts in this survey must be applied to the total population with reservations, for the socio-economic, educational group studied, were the lower middle class and may have dental care and nutritional problems (to mention a couple), which were not recorded in this survey.

The mean Russell periodontal index was significantly higher at the 0.001 level, in the diabetic group than in the non-diabetic control group, when two strong variables age and sex were kept constant.

The mean debris score was higher in the diabetic group than in the non-diabetic group. The 25-29 year age group in the diabetics showed a higher mean debris score than all other groups, this group also had according to the type of treatment used, the greatest percentage of

severely affected diabetic patients - a personal clinical observation was that especially in this young diabetic group, the diabetic patients were not as vital as the non-diabetic group, many showed actual antagonism to dental advice, and according to the attending physicians were antagonistic to medical treatment - they could be controlled for short periods of time but when good control had been established they ceased to attend the clinic and returned only when gross diabetic signs and symptoms had reappeared. This antagonism to following a strict medical regime may have applied to any dental care routine and could be responsible for the higher mean debris score shown in this group. Older diabetic patients however, in most cases were keen to listen to dental advice and generally showed a questioning interest in periodontal health, this paralleled their acceptance of their diabetic condition and their resolve to live with their diabetic problems.

The calculus scores showed the most significant correlation with the Russell periodontal index in both groups, however the mean calculus score was higher in the whole diabetic group and in all the diabetic subgroups than in the control. Calculus in this study appears to be the strongest factor in the aetiology of periodontal disease. In the younger group the mean calculus score

and the mean periodontal score show a degree of comparison which is paralleled in the older non-diabetic groups, but not in the 30-39 and 40-49 year age groups of diabetics where the periodontal score increased to a greater degree, and it is apparent that some factor other than calculus is responsible for this increased degree of periodontal disease- perhaps this factor is due to diabetes and its degenerative vascular changes.

The period the patient was known to have diabetes did not have any significant correlation with periodontal disease in this survey. The length of time a patient had suffered from diabetes mellitus was not truly recorded, but merely the period of time since the patient had been diagnosed diabetic. At the present time there is no known method of determining how long an individual has been a diabetic, but undiagnosed.

The manner of diabetic control did not have any significant difference between the insulin treated and non-insulin treated groups, even though the insulin treated group showed a lower mean periodontal score.

The well controlled diabetic patients showed a lower mean periodontal index and also showed a lower mean debris and calculus score; there was also a negative correlation of some significance with the calculus index, that is a

well controlled patient had a lower calculus index. Noticeable again was that the well controlled patient in this survey appeared more alert and interested in their medical and dental health than did the diabetic patient in poor or only fair control.

Toothbrushing frequency was the most unreliable fact recorded, by reason of the fact that it was felt some patients were not honest in their answer to this question, and so in spite of the fact that if there was doubt, the lower score was registered, the figures on toothbrushing frequency must be viewed with reservation. The manner in which most patients used a tooth brush left much to be desired, all patients in this survey were instructed in the aims of good oral hygiene, and the great majority admitted that they fell far short of this ideal. A few patients were achieving good results. One patient had festooned gingival tissue and abraded gingival teeth margins due mainly to her tooth brush technique, and she had a clean healthy mouth, although she was forty-four years of age, and a diabetic in fair control only, she showed a low calculus score (1.00), and also a very low Russell periodontal index (0.42). This one case does not prove the point, but at least demonstrates the fact that all diabetics do not necessarily have a high perio-

dontal index even in this older age group.

There was a lower mean debris score, a lower mean calculus score and a lower mean Russell periodontal score in all groups of patients whether diabetic or not who brushed their teeth twice or more daily if compared with patients who brushed their teeth once or less per day.