TEETH OF 5-YEAR-OLD LONDON SCHOOLCHILDREN (1957)

WITH A COMPARISON OF THE RESULTS
OBTAINED FROM 1929 TO 1957

BY

MAY MELLANBY, M.A., Sc.D.

W. J. MARTIN, Ph.D., D.Sc.

AND

DAVID BARNES, L.D.S., B.D.S.

With the assistance of GWENNETH NEAL

From 5, East Heath Road, Hampstead, N.W.3, and
Statistical Research Unit, London School of Hygiene
and Tropical Medicine

The first of a series of detailed surveys of the deciduous teeth of 5-year-old children was undertaken by one of us (M.M.) in 1929 at the request of the Board of Education. The children attended London County Council schools representative of the different parts of the Metropolitan area. Inspections at the same, or similar, schools have been made with colleagues at two-yearly intervals from 1943 to 1957, with the exception of 1953. In addition, children living in residential homes (institutions) and those attending private schools were visited in 1945 and 1950 for comparison with the London County Council children. (References to all these are given at the end of this report.)

The probe-and-mirror method of examination has been used throughout, and the criteria for structure and caries employed were those developed by Mellanby (1934). Both the method and the criteria have been described in detail in previous reports of this series.

When the surface of a tooth is smooth and shiny it is said to be hypoplasia-free—that is, the structure is good (Hy₀). Any roughness is graded according to type and degree, differentiation being made between the comparatively rare gloss hypoplasia (G-Hy) and the common M-hypoplasia (M-Hy) (King, 1940). The surface structure of the teeth is expressed both as the percentage incidence of the different grades of hypoplasia and as the average M-hypoplasia figure (A.H.F.). The latter gives a rough computation of the extent of this type of defect and is obtained by allotting a number to each tooth (1 for M-Hy₁, 2 for

M-Hy₂, and 3 for M-Hy₃) and dividing the sum of these by the number of teeth. Those showing gross hypoplasia and those so carious that assessment is impossible are excluded.

A tooth is regarded as caries-free when no disease can be diagnosed by the method of examination employed. Caries is expressed as a percentage incidence—that is, d.e.f. per 100 teeth—and as the average caries figure (A.C.F.), which is estimated in a similar way to the A.H.F. The numbers 1, 2, and 3, are allotted to carious teeth according to the amount of tooth involved. Missing molars and canines are presumed to have been extracted for severe caries and are included in the C₃ group, while missing incisors (mainly lower centrals) are counted as having been naturally shed and are omitted from the analysis. The maximum value for both A.H.F. and A.C.F. is 3.

The Board of Education (1931) analysed the data obtained in the 1929 investigation, but published only the figures relating to *children* and not to individual teeth. A child was said to be caries-free who had no recorded decayed teeth, or only one, two, or three teeth with grade 1 caries, the second group being included because such a small proportion of the children were "caries-free." For the purpose of comparison the same classification has been perpetuated throughout these surveys, but, in addition, the results have been analysed for the incidence and extent of hypoplasia and caries in *each type of tooth*.

Results

Teeth Present.—In 1957 the dental condition of 1,241 children were recorded. All of them had had their fifth but not their sixth birthday. At the time of the inspection there were 22,587 deciduous teeth *in situ* out of a possible 24,820 (91%). The percentage distribution of the individual types was similar to that in 1955 and in the earlier surveys (*Brit. med. J.*, 1957, 2, 318)—namely:

	Upper Jaw	Lower Jaw
Central incisors	90.5	77.6
Lateral	96.4	96.7
Canines	99.4	99.6
1st molars	91.6	82.9
2nd	93.6	81.9

Surface Structure.—An examination was made of the surface structure of 98% of the teeth present in the mouth (see above) and the results for individual teeth compared with 1955 figures are given in Table I. All the teeth except the lower molars had a better structure in 1957 than in 1955. In both years the lower teeth had fewer defects than the upper. The best structure of all occurred in the lower incisors, in which 80.3% of the centrals and 64.1% of the laterals were non-hypoplastic, and the worst in the molars,

TABLE I.—Surface Structure of Different Types of Teeth (1957 compared with 1955)

Type of Tooth	Total No. of Teeth Examined for Structure		Percentage of Teeth								Total Percentage of Teeth with M-Hypoplasia		Percentage of Teeth with Gross Hypoplasia		A.H.F.*	
			Hy ₀		M-Hy ₁		M-Hy ₂		M-Hy ₃							
	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957
Upper jaw:																
Central incisors ..	2,118	2,166	26.4	51.7	33.2	36.6	27.3	8.8	7.3	0.1	67.9	45.5	5.7	2.8	1.17	0.56
Lateral " ..	2,282	2,284	34.9	45.2	39.4	44.4	17.6	8.3	3.2	0.1	60.3	52.8	4.8	2.0	0.89	0.62
Canines " ..	2,392	2,432	37.5	41.1	43.4	51.6	14.0	5.9	2.4	0.1	59.9	57.6	2.6	1.3	0.81	0.64
1st molars ..	2,157	2,196	9.9	14.6	34.2	46.9	42.7	36.8	8.2	0.9	85.1	84.6	5.1	0.8	1.52	1.24
2nd " ..	2,263	2,293	8.9	13.7	32.3	45.7	47.6	37.6	9.5	2.4	89.7	85.6	1.5	0.7	1.59	1.29
Total upper jaw ..	11,212	11,371	23.8	33.3	36.7	45.2	29.6	19.3	6.0	0.7	72.3	65.2	3.9	1.5	1.19	0.87
Lower jaw:																
Central incisors ..	1,883	1,917	83.6	80.3	14.8	18.8	0.8	0.6	0.0	0.1	15.6	19.5	0.8	0.2	0.17	0.20
Lateral " ..	2,336	2,389	77.4	64.1	20.7	35.0	1.2	0.8	0.1	0.0	22.0	35.7	0.6	0.2	0.23	0.37
Canines " ..	2,399	2,460	61.7	56.6	30.1	38.9	3.7	2.3	0.3	0.0	34.1	41.3	4.2	2.1	0.40	0.45
1st molars ..	1,893	2,001	22.1	27.8	35.4	46.5	32.7	24.3	6.2	0.4	74.3	71.3	3.6	0.9	1.24	0.97
2nd " ..	1,904	1,970	11.7	26.3	34.3	43.3	40.7	28.2	11.4	1.4	86.4	72.9	1.9	0.8	1.53	1.04
Total lower jaw ..	10,415	10,737	52.8	51.6	27.0	36.7	14.7	10.5	3.3	0.4	44.9	47.5	2.2	0.9	0.68	0.59
Grand Total ..	21,627	22,108	37.8	42.2	32.0	41.0	22.4	15.0	4.7	0.6	59.1	56.6	3.1	1.2	0.94	0.74

* A.H.F. = $\frac{\text{Total M-hypoplasia figure}}{\text{Total number of teeth examined for structure (excluding those with gross hypoplasia)}}$

TABLE II.—Incidence and Extent of Caries in Different Types of Teeth (1957 compared with 1955)

Type of Tooth	Total No. of Teeth Assessed for Caries (inc. Extractions)		Percentage of Teeth								Total Percentage of Carious Teeth (d.e.f. per 100 Teeth)		A.C.F.*	
			C ₀		C ₁		C ₂		C ₃					
	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957	1955	1957
Upper jaw:														
Central incisors ..	2,179	2,245	72.2	74.4	6.8	6.2	12.3	12.3	8.7	7.0	27.8	25.6	0.57	0.52
Lateral " ..	2,342	2,392	82.3	82.6	4.9	4.0	8.2	7.2	4.6	6.2	17.7	17.4	0.35	0.37
Canines " ..	2,410	2,482	88.9	90.5	3.2	2.2	5.3	4.6	2.6	2.7	11.1	9.5	0.22	0.20
1st molars ..	2,410	2,482	58.3	58.5	10.2	8.3	15.6	16.6	15.9	16.6	41.7	41.5	0.85	0.91
2nd " ..	2,410	2,482	41.9	37.7	18.4	25.0	22.4	22.4	17.3	14.9	58.1	62.3	1.15	1.14
Total upper jaw ..	11,751	12,083	68.6	68.5	8.8	9.2	12.8	12.7	9.9	9.6	31.4	31.5	0.64	0.63
Lower jaw:														
Central incisors ..	1,887	1,926	94.8	94.6	2.3	2.9	2.5	2.0	0.5	0.4	5.2	5.2	0.09	0.08
Lateral " ..	2,340	2,399	94.7	96.3	2.1	1.3	2.6	1.9	0.6	0.5	5.3	3.7	0.09	0.07
Canines " ..	2,410	2,482	91.2	92.2	2.4	2.1	4.5	4.2	1.9	1.5	8.8	7.8	0.17	0.15
1st molars ..	2,410	2,482	37.5	37.8	7.3	6.8	24.5	26.5	30.7	28.9	62.5	62.2	1.48	1.47
2nd " ..	2,410	2,482	29.8	28.2	16.3	19.9	19.3	20.1	34.5	31.7	70.2	71.8	1.59	1.55
Total lower jaw ..	11,457	11,771	68.3	68.5	6.3	6.8	11.1	11.4	14.3	13.3	31.7	31.5	0.71	0.69
Grand Total ..	23,208	23,854	68.4	68.5	7.5	8.0	12.0	12.1	12.1	11.4	31.6	31.5	0.68	0.66

* A.C.F.— $\frac{\text{Total caries figure}}{\text{Total number of teeth (including extractions)}}$

particularly the uppers, where only 14.6% of the first and 13.7% of the second were free from hypoplasia.

Very few teeth had any mottling, and when present it was very mild. Such teeth were graded for M- and G-hypoplasia in the usual way.

Incidence and Extent of Caries.—Table II compares the incidence and extent of caries for each type of tooth and for all types together in 1957 and 1955. The two series were in close agreement. The proportion of carious teeth and the average caries figures in both upper and lower jaws, separately and combined, was approximately 31% and 0.6%. The lower incisors had the least caries (5.2% in the centrals in both years and 3.7% in the laterals in 1957, as against 5.3% in 1955) and the lower second molars the most (71.8% and 70.2% respectively). The upper first molars had less caries than the other molars (20–30% less in 1957 as compared with 16–29% less in 1955).

TABLE III.—Treatment of Caries (1943 to 1957)

Year	Total No. of Carious Teeth (including Extractions)	Treatment			Total Percentage of Carious Teeth Treated
		% Extracted	% Silver Nitrate	% Filled	
1943	10,886	15.7	6.7	2.7	25.0
1945	3,545	9.6	2.8	2.4	14.8
1947	6,245	15.6	2.4	4.4	22.4
1949	3,553	15.3	0.6	3.9	19.8
1951	7,412	13.0	0.1	6.1	19.2
1955	7,326	16.7	2.3	11.1	30.1
1957	7,510	17.0	0.6	10.7	28.3

The average number of carious teeth per child was 6.1% in both years, but if the "caries-free" children were excluded the figure dropped from 7.2% in 1955 to 6.9% in 1957. The percentage of children caries-free or nearly so was also similar—20.7 in 1957 and 21.2 in 1955—but the percentage of "caries-free" children was less in the last survey—namely, 11.9 compared with 15.5.

Treatment of Caries.—Table III shows that in 1957, as in 1955, rather less than one-third of the carious teeth had been

treated, approximately 17% had been filled, and 11% extracted. Only 0.6% appeared to have been painted with silver nitrate in 1957 compared with 2.3% in 1955, which accounts for the slight difference in the total treated.

TABLE IV.—Caries Related to Superficial Staining of Teeth (1943 to 1957)

Year	Percentage of Carious Teeth in Children with:		
	No Stain	Black or Dark-brown Stain	Green Stain
1943	30.1	19.3	33.4
1945	23.1	15.4	33.0
1947	19.8	12.4	26.0
1949	25.8	16.9	30.0
1951	25.5	14.4	33.6
1955	29.1	20.2	39.2
1957	32.0	22.0	31.2

Caries and Superficial Staining of Teeth.—In the recent examination as in 1955 (Table IV), the children with black or dark-brown stain on any tooth had a smaller percentage of caries (22%) than either the children with no stain (32.0%) or those with green stain (31.2%).

Comments and Conclusions

It may be said, after reviewing these results, that the caries picture of the 5-year-old children in the London County Council schools has shown little or no change since 1955, whether considered per child or per tooth. But, as mentioned in previous reports, there have been many variations both in structure and in caries experience of this age group since the original 1929 investigation.

The proportion of teeth present at examination was, on the whole, similar in the seven inquiries from 1943 to 1957.

The structure of the individual teeth has varied from year to year. There was in general an improvement up to 1947, but, later, variations occurred for which we cannot

TABLE V.—Structure—Caries Relationship (1957)

Grade of Structure	Incisors			Canines			Molars			All Teeth		
	Total Examined	% Carious	A.C.F.	Total Examined	% Carious	A.C.F.	Total Examined	% Carious	A.C.F.	Total Examined	% Carious	A.C.F.
Hy ₀ ..	5,223	6.9	0.12	2,392	4.1	0.08	1,712	39.3	0.71	9,327	12.1	0.22
M-Hy ₁ ..	3,003	14.5	0.27	2,212	9.7	0.18	3,860	50.9	0.92	9,075	28.8	0.52
M-Hy ₂ ..	408	37.5	0.72	200	16.5	0.30	2,711	61.5	1.17	3,319	55.8	1.06
M-Hy ₃ ..	7	71.4	2.00	4	25.0	0.50	111	78.4	1.75	122	76.2	1.72
G-Hy ..	115	37.4	0.63	84	17.9	0.25	66	69.7	1.33	265	39.2	0.68

TABLE VI.—Comparison of Caries in Upper and Lower Teeth (1943 to 1957)

Year	Percentage of Carious Teeth		A.C.F.	
	Upper Jaw	Lower Jaw	Upper Jaw	Lower Jaw
1943	33.2	26.9	0.69	0.62
1945	28.5	24.5	0.57	0.54
1947	21.0	19.5	0.41	0.44
1949	26.7	26.6	0.52	0.57
1951	26.9	28.2	0.51	0.60
1955	31.4	31.7	0.64	0.71
1957	31.5	31.5	0.63	0.66

account. The present position is similar to that of 1951 for all teeth combined, but there are differences between the types of teeth. As already mentioned, the structure is better in 1957 than in 1955.

The relationship between the external structure of a tooth and caries experience (Table V) was in general the same as in the comparable surveys made since 1943. For all types of teeth grouped together caries was present in only 12.1% of those with no recorded enamel defects (Hy₀), a higher figure than previously found, but with severe defects the disease was much more prevalent. For instance, caries was found in 76.2% of teeth with grade three M-hypoplasia (M-Hy₃) and in 39.2% of those with the gross forms of defect (G-Hy). These figures nevertheless support the con-

Some of the factors which contributed to the marked improvement of the caries picture between 1929 and 1947 and the subsequent deterioration in later years, have been discussed at length in the previous reports. No further evidence has been forthcoming to modify the tentative conclusions given there—namely, that the reduction in the disease was partly the result of more scientifically controlled nutrition of pregnant women and infants during the war and post-war period of rationing, when among other things the calcifying properties of the diet were increased. The subsequent freer choice of diet when cheaper foods, including cereals, were more easily obtainable, together with the reduction in the consumption of milk and cod-liver oil, could account for some of the deterioration from 1947 to 1955. The work of Holloway *et al.* (1958) suggests that some of the increase in the incidence of caries in recent years may be due to the rapid growth in popularity of iced lollies and similar confections. The fluorine in the water could not have been concerned in the changes noted in these reports, as it has remained low and constant throughout.

Our thanks are extended to many who have helped directly or indirectly with the investigations. We are particularly indebted to the London County Council and Dr. J. A. Scott for permission to carry out the survey, to the head teachers and their assistants for the trouble they took to make our visits to the schools such a pleasure, and to the Medical Research Council for

TABLE VII.—Distribution of Caries (1953 to 1957)

Year	Percentage of Carious Teeth									
	Central Incisors		Lateral Incisors		Canines		1st Molars		2nd Molars	
	Upper Jaw	Lower Jaw	Upper Jaw	Lower Jaw	Upper Jaw	Lower Jaw	Upper Jaw	Lower Jaw	Upper Jaw	Lower Jaw
1943	37.6	4.9	20.3	3.7	9.5	6.9	42.0	54.0	56.5	61.0
1945	29.5	1.7	14.9	2.1	7.5	5.9	38.9	48.6	51.4	58.8
1947	22.2	1.7	10.6	1.7	6.9	4.1	30.6	43.3	34.4	43.0
1949	30.1	3.3	14.5	2.6	9.1	5.5	35.7	54.0	44.2	61.3
1951	30.0	3.8	15.4	3.5	7.2	5.6	34.2	56.9	47.7	65.1
1955	27.8	5.2	17.7	5.3	11.1	8.8	41.7	62.5	58.1	70.2
1957	25.6	5.2	17.4	3.7	9.5	7.8	41.5	62.2	62.3	71.8

clusion drawn from earlier work that the better the structure of a tooth, as diagnosed by the method previously described, the less likely is it to become carious.

The incidence and extent of caries declined from 1943 to 1947 but rose after that date until 1955, since when there has been little or no change. A comparison of the carious teeth in the upper and lower jaws from 1943 to 1957 (Table VI) is of interest. In 1943 the upper jaw had 6.3% more carious teeth than the lower. The decrease in the incidence of the disease noted up to 1947 was less in the lower than in the upper jaws, and the difference between the two fell to 1.5%. The rise in the proportion of carious teeth subsequent to 1947 was greater in the lower jaw, and in 1951 the percentage of such teeth in the lower was 1.3% greater than those in the upper jaw. By 1955, and also in 1957, the percentage in the two jaws was the same—namely, 31. This change in distribution of the disease between the two jaws is analysed in Table VII, which shows that the trend is mainly due to a decrease in caries in the upper incisors associated with a larger increase in the lower molars compared with the upper.

The proportion of carious teeth filled has increased from approximately 2.5 to 11.0% since 1943, the rise being most marked in the last two examinations (Table III). Although the percentage of teeth extracted has varied to some extent from year to year, it was also greater in 1955 and 1957 than at any of the previous inspections.

In 1957 the children with black or dark-brown stain had a smaller percentage of carious teeth than the children with no stain or green stain, as in previous surveys. The children with green stain in 1957, however, had approximately the same percentage of diseased teeth as the children with no stain, while in the preceding surveys they had a larger percentage.

financing the work. We would also like to acknowledge gratefully the assistance given by Misses I. Allen and B. Hafner in the tabulation of the data and to Dr. P. J. Holloway for his help and criticism during the preparation of the report.

REFERENCES

- The earlier surveys from 1943 onwards to which reference is made in this paper were all published in the *British Medical Journal*, as follows: 1944, 1, 837; 1946, 2, 565; 1947, 1, 751; 1948, 2, 409; 1950, 1, 1341; 1951, 1, 51; 1954, 2, 944; 1957, 2, 318.
- Board of Education (1931). Committee on Adenoids and Enlarged Tonsils. Second Interim Report: "The Association of Rickets and Dental Disease with Adenoids and Enlarged Tonsils." H.M.S.O., London.
- Holloway, P. J., Mellanby, M., and Stewart, R. J. C. (1958). *Brit. dent. J.*, 104, 205.
- King, J. D. (1940). *Spec. Rep. Ser. med. Res. Coun. (Lond.)*, No. 241.
- Mellanby, May (1934). *Ibid.*, No. 191, pp. 33 and 68.

"It seems to me certain that there should be no strife between science and religion, for the great Creator of living beings was also the Creator of the harsh and ruthless natural laws we call Darwinic evolution. . . . The question arises, does the Creator now content himself with allowing human beings to follow their own dictates as a self-governing colony provided they keep themselves within the natural laws which have been arranged for them; or does He occasionally intervene in an "unnatural" or "supernatural" way? That question I think cannot scientifically be answered. Hardly anything happens which cannot be explained by natural causes, but revelations occur which are sudden and surprising enough to suggest an "unnatural" or "supernatural" origin as if the Creator had Himself directly intervened in the course of a human life. Who would be bold enough absolutely to deny the possibility of such an intervention?"—F. Parkes Weber, *The Advent of Life: an Agnostic's Dream About the Creation* (H. K. Lewis, 1958).