remission is interesting. This improvement appears to have continued of its own accord, and the occasional out-patient "maintenance" treatment which had been envisaged has been unnecessary. This simple decrease and disappearance of symptoms, as Meduna (1953) has indicated, is seen quite as often as a cathartic emotional release, which did not occur in this case.

Suppose there did exist in the genesis of these tics and this repetitive speech disturbance a self-perpetuating process by which the muscular and vocal discharges themselves provide the stimulus for a further discharge. In these circumstances a manœuvre designed to interrupt this process, by lowering the excitability of the system, then seems less empirical than it first appears. After inhalation of CO₂ the disturbance in the plasma hydrogen-ion concentration is very considerable (pH 7.2→6.7—A. Bartholomew, personal communication). Adrian (1930) noted that the hyper-excitability and spontaneous firing in peripheral nerve preparations was prevented by transfer to an atmosphere of 5% CO₂, and Lorente de Nó (1947) has shown that a similar concentration of CO₂ raises the demarcation potential (4 millivolts, approximately 60%) and also the threshold for stimulation in peripheral nerve.

It is, of course, not possible to argue directly from results obtained in isolated amphibian core conductors when attempting to understand phenomena in the multisynaptic systems which must be concerned in the reverberating neuronal networks that are postulated in higher mammals (Ashby, 1952): though there is evidence that the synapse is the more sensitive to changes in hydrogen-ion concentration (Eccles, 1953). Speculation on the mode of action of any apparently successful but empirical therapy is especially tempting in a condition whose outlook has been regarded as so grave. Whatever this mode of action and in whatever terms, whether neurological or psychological, it is stated, the fact remains that the CO₂ inhalations appear to have initiated in this case a return towards normality.

Summary

A classical case of Gilles de la Tourette's disease is described in which coprolalia, gradually increasing in severity over a period of four and a half years, had forced the patient into becoming a recluse, confined to the home in a state of almost complete social isolation. Though psycho-analytically orientated psychotherapy produced no change in the frequency or form of the patient's utterances, carbon dioxide treatment initiated an almost immediate improvement in symptoms which made discharge from hospital and rapid return to work possible. This improvement has been maintained over the 18-months period of follow-up. The difficulties encountered by the author and others in the psychotherapy of this condition are discussed, and some speculations are made upon the possible neurophysiological basis for the interruption of these repetitive and apparently self-perpetuating speech disturbances.

I thank Dr. Kräupl-Taylor for his advice and for kind permission to publish this case

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AGE AT WHICH THE DECIDUOUS TEETH ARE SHED

BY

E. M. B. CLEMENTS, M.B., B.S.

E. DAVIES-THOMAS, M.R.C.S., L.R.C.P.
L.D.S. R.C.S.

AND

KATHLEEN G. PICKETT, B.Sc.

(From the Department of Anatomy, University of Birmingham)

The age at which the milk teeth of children are shed is a subject which has been relatively little studied. In 1923 Hellman gave figures based on a survey of American boys and girls from poor and wealthy homes. In this country, a survey of children at an institution was made by Stones, Lawton, Bransby, and Hartley in 1951. This gap in our knowledge is surprising, for there is good reason to believe that the age at which the deciduous teeth are shed may influence the age at which the succeeding permanent teeth erupt (Leslie, 1951).

The statistics presented in this report have been obtained by new methods which allow a more accurate assessment of mean shedding times to be made than has hitherto been possible.

Method

The analysis has been made from data relating to a sample of 1,427 boys and 1,365 girls aged 5 to 13 years, attending infant, junior, and secondary modern schools in Birmingham. The children were examined during the course of the Birmingham Anthropometric Survey, and are fully representative of the elementary-school population of the city.

At the examination a series of anthropometric measurements and dental observations were made on each child, the latter by the same observer throughout (E. D.-T.). An account of the information recorded and the way in which it was prepared for analysis was given in a previous paper (Clements, Davies-Thomas, and Pickett, 1953).

For the purpose of this analysis, all deciduous teeth seen in the jaw were coded as "present" and missing teeth as "shed," the latter category including teeth either shed or extracted. The space might be empty or be filled by a permanent tooth.

The coded records in the form of punched cards were sorted into order of ascending age and then formed into groups with an age range of three months. Within each of these age groups the proportion of children with a particular deciduous tooth present was calculated. This was done for each deciduous tooth in turn. The proportion gradually decreases with age until all the children have shed the tooth.

The observed and expected shedding frequencies of boys' upper first deciduous molar tooth.

The age at which 50% of the children have the tooth and 50% have not may be accurately calculated from such a series of observations by a statistical method recently devised (Finney, 1952). The standard deviation of the distribution, which is a measure of the range, may also be obtained. This technique of probit analysis has been used throughout, and the close correspondence of observed and expected shedding frequencies derived from the analysis confirmed that it is applicable to the data. The Chart on the previous page is a diagrammatic representation of these frequencies in the upper first deciduous molar tooth. An account of the method of analysis, applied to similar observations on permanent teeth, has been given in an earlier paper (Clements *et al.*, 1953).

Results

The statistics have been computed for the right and left sides of the upper and lower jaws of boys and girls separately. Comparison shows no difference between the sides other than would be expected to arise from random errors of sampling. For this reason the data presented here relate only to the right side of the jaws.

Mean Time at Which Teeth are Shed.—The mean times at which teeth are shed in the right upper and lower jaw are given in Table I for both sexes, with the standard error of

TABLE I.—Mean Shedding Times, Standard Errors, Standard Deviations, and the 5% and 95% Limits of Mean and of Distribution, for Teeth of Boys and Girls in Right Upper and Lower Jaws

Tooth	Mean and Error (Months)	Limits of Mean		S.D.	Limits of Distribution	
		5% Limit	95% Limit		5% Limit	95% Limit
Boys						
Upper jaw:						
A	80.23 ± 0.73	79.03	81.43	11.78	60.91	99.55
B	91.13 ± 0.72	89.95	92.31	11.91	71.60	110.66
C	133.10 ± 0.90	131.62	134.58	18.04	103.51	162.69
D	105.13 ± 1.15	103.25	107.01	27.47	60.07	150.19
E	115.25 ± 1.16	113.35	117.15	28.79	68.03	162.47
Lower jaw:						
A	72.52 ± 0.75	71.29	73.76	9.97	56.17	88.88
B	85.74 ± 0.65	84.68	86.81	9.38	70.35	101.13
C	122.08 ± 0.85	120.69	123.47	16.00	95.84	148.32
D	98.89 ± 1.39	96.61	101.17	33.31	44.26	153.52
E	106.71 ± 1.35	104.50	108.92	34.93	49.42	163.99
Girls						
Upper jaw:						
A	77.89 ± 0.61	76.89	78.89	8.95	63.21	92.57
B	87.80 ± 0.75	86.57	89.02	12.55	67.22	108.38
C	123.81 ± 0.89	122.36	125.26	16.98	95.97	151.66
D	101.94 ± 1.24	99.91	103.97	27.96	56.09	147.79
E	112.48 ± 1.15	110.59	114.37	27.37	67.59	157.37
Lower jaw:						
A	68.21 ± 0.61	67.20	69.21	7.05	56.64	79.77
B	81.08 ± 0.74	79.87	82.30	10.70	63.53	98.64
C	110.52 ± 0.77	109.25	111.79	14.18	87.27	133.77
D	95.99 ± 1.34	93.78	98.19	31.15	44.90	147.08
E	101.95 ± 1.26	99.89	104.02	30.53	51.89	152.02

the mean, the standard deviation, and the 5 to 95% fiducial limits of the distribution: 90% of children fall within these limits. Outside them are only the earliest 5% and the latest 5%.

Effect of Socio-economic Background on Time at Which Teeth are Shed

The shedding times given in Table I are obtained from data relating to children of all types of socio-economic background. It was possible that variation in these times might be associated with differing socio-economic backgrounds. The children have therefore been divided into three groups, each varying in this respect. Their allocation to each group depends upon their parents' occupation, and is based on the classification used by the Registrar-General (1951). The first group includes his social classes I and II, formed of professional and intermediate workers. The second is equivalent to his social class III, consisting of skilled

workers. The third includes his social classes IV and V, and consists of semi-skilled and unskilled workers.

The mean ages at which the deciduous teeth were shed were computed for these three socio-economic groups whenever sufficient data were available. In the first group, satisfactory estimates could be obtained only for the lower first deciduous incisor, the upper and lower first deciduous molar, and the lower second deciduous molar teeth of boys. Although the evidence is incomplete, these indicate that, on the average, deciduous teeth are shed earlier in children from the first socio-economic group than in those from the second. The lower first incisor teeth show a difference of 4.65 ± 3.68 months in mean shedding age between these two groups. The upper first molar teeth show a difference of 20.22 ± 2.72 months, the lower first molar teeth one of 18.99 ± 4.17 months, and the lower second molar teeth one of 20.68 ± 5.70 months. The differences shown with the molar teeth are large and statistically significant. No significant differences were found to exist between the mean times at which teeth are shed among children from the second and third socio-economic groups.

Hellman (1923) provides estimates of the mean shedding times for deciduous teeth in samples of wealthy and poor children. These indicate an earlier shedding time for the first and second incisors and canine teeth in both boys and girls from the wealthy group, with the exception of the girls' lower first incisor and the boys' upper canine. The differences are very small, and none is statistically significant, but their relative consistency may indicate a trend. Hellman found that, unlike the incisor and canine teeth, the first and second molar teeth were shed, on the average, later in wealthy than in poor children. This is not in accord with our data, and it seems evident that these teeth show very variable mean shedding times. Differences in extraction rates may be involved.

Difference in Mean Times at Which Teeth are Shed

Boys and Girls.—The difference between the mean shedding times of the deciduous teeth of boys and girls is given in Table II. Without exception, boys show a later mean

TABLE II.—Differences Between Mean Shedding Times, with Standard Errors, of Teeth of Boys and Girls in Right Upper and Lower Jaws, and Between the Upper and Lower Jaws in Same Sex

Tooth	Difference Between Mean Shedding Times in Months with S.E.			
	Boys-Girls		Upper-Lower	
	Right Upper Jaw	Right Lower Jaw	Boys	Girls
A	+2.34±0.95†	+4.32±0.97†	+7.71±1.05†	+9.68±0.86†
B	+3.33±1.04†	+4.66±0.99†	+5.39±0.97†	+6.72±1.05†
C	+9.29±1.26†	+11.56±1.15†	+11.02±1.24†	+13.29±1.18†
D	+3.19±1.69	+2.90±1.93	+6.24±1.80†	+5.95±1.83†
E	+2.77±1.63	+4.75±1.84†	+8.54±1.78†	+10.53±1.71†

† Indicates a probability of less than 1%. Teeth A, B, C, D, and E represent 1st and 2nd incisors, canines, and 1st and 2nd molars respectively.

shedding time than girls. These differences are statistically significant for the upper and lower first and second incisors, canines, and second lower molar teeth. The variation between the sexes in the canines is particularly pronounced. The average difference is 4.91 ± 0.97 months, and compares well with Hellman's finding that girls shed their teeth 4½ months earlier, on an average, than boys. A similar conclusion was reached by Stones *et al.* (1951).

Upper and Lower Jaws.—The difference between the mean shedding times of corresponding teeth in the upper and lower jaws are given in Table II for boys and girls separately. In both sexes the mean times are later in the upper jaw than in the lower jaw, and the differences are all statistically significant. The average difference is 8.51 ± 0.82 months, and is very near to Hellman's estimate of 7 months. Stones *et al.* (1951) also found that the first and second upper incisors and upper canines were shed later than the corresponding teeth in the lower jaw, but that the lower molar teeth were shed later than the upper ones.

Sequence in Which Deciduous Teeth are Shed

The usual order in which the deciduous teeth are shed has been determined from the mean times given in Table I. The order is the same in the upper and lower jaws of both boys and girls, and the sequence may be represented as follows:

$$\frac{i_1 \quad i_2 \quad c \quad m_2 \quad m_1}{i_1 \quad i_2 \quad c \quad m_2 \quad m_1}$$

The sequence in which the incisor teeth are shed is the same as that found by Hellman (1923) and by Stones *et al.* (1951), but this is not so for the canines and molars. In the two latter surveys the order in which these teeth are shed differs between boys and girls.

Time Between Shedding Deciduous Teeth and Eruption of Permanent Teeth

Estimates of the time interval between the shedding of the deciduous teeth and the eruption of the corresponding permanent teeth are given in Table III. The mean shedding

TABLE III.—Time Interval in Months Between Mean Time of Shedding Deciduous Teeth and Mean Time of Eruption of the Permanent Teeth

Tooth	Boys				Girls			
	Birmingham	Hellman		Stones <i>et al.</i>	Birmingham	Hellman		Stones <i>et al.</i>
		Wealthy	Poor			Wealthy	Poor	
Upper Jaw								
A	3.90	3.72	3.84	5.40	1.57	0.00	1.92	3.84
B	7.04	7.20	6.48	6.72	6.00	7.32	3.84	6.24
C	4.46	6.60	10.20	8.16	4.26	5.16	4.20	13.80
D	19.83	2.88	11.52	8.16	15.51	2.40	9.12	3.96
E	22.97	7.08	13.44	3.36	20.28	4.92	8.16	4.44
Lower Jaw								
A	0.44	0.48	1.44	0.36	1.01	0.12	0.84	4.08
B	1.89	2.88	1.92	1.56	3.09	2.16	0.72	6.60
C	4.08	5.64	2.40	8.52	2.38	2.76	0.36	11.04
D	37.31	5.04	31.32	12.00	30.34	4.92	22.32	12.96
E	41.16	4.56	33.72	12.36	37.67	9.36	26.64	14.64

Teeth A, B, C, D, and E represent 1st and 2nd incisors, canines, and 1st and 2nd molars respectively.

times in Table I have been combined with mean eruption times obtained from the same sample of Birmingham children (Clements *et al.*, 1953). Estimates derived from the data of Hellman (1923) and of Stones *et al.* (1951) have also been made, and are included in Table III.

The average intervals of time between shedding the deciduous upper and lower first and second incisors and canines and the eruption of corresponding permanent teeth are small and very similar in all three surveys. The intervals between shedding and eruption of molar teeth, however, are generally greater and differ between the surveys. The Birmingham data show the largest intervals here, followed by Hellman's sample of children from poor homes. All the estimates indicate, however, that the average interval between shedding and eruption of molar teeth is greater in the lower than the upper jaw.

Discussion

On the average, the children in the Birmingham survey shed their teeth earlier than did either wealthy or poor American children in 1923 (Hellman, 1923). Their mean shedding times are also earlier than those estimated from a sample of English children living in an institution (Stones *et al.*, 1951). The discrepancies between the two English surveys may be due in part to the inevitably more restricted nature of the institutional data, which are based upon smaller numbers and a greater homogeneity of material than occurs in the Birmingham sample.

The average time at which teeth are shed is also linked with the extraction rate, where extracted teeth are included in the data. Stones *et al.* (1951) show that there may be as much as twelve months' difference between the average shedding time of the molars when extracted teeth are included and excluded. This may account for many differences

between the surveys, particularly where the molars are involved. The incidence of caries, which has been shown to occur most often in these teeth (Mellanby and Mellanby, 1950) may vary greatly between one group and another. It is, in fact, known to be lower in the teeth of children at an institution than in those living at home (Mellanby and Mellanby, 1951).

Both Hellman's data (1923) and the Birmingham Survey material indicate that there is at least a tendency towards an earlier mean shedding time for the deciduous teeth of children with a superior socio-economic background compared with the teeth of children less well placed. This may be another factor leading to heterogeneity between the English surveys. It also suggests that environmental factors such as living conditions and nutritional standards are of great significance to the life of the teeth. Earlier shedding of milk teeth leading to earlier eruption of permanent teeth may be another aspect of the well-known trend towards an earlier maturity as standards of life improve.

Summary

The mean times at which the deciduous teeth are shed have been computed from a sample of 1,427 boys and 1,365 girls aged 5 to 13 years, attending elementary schools in Birmingham.

Children with a superior socio-economic background tend to shed their milk teeth earlier than others.

Boys shed their milk teeth an average of 5 months later than girls. The teeth in the upper jaw are shed an average of 8½ months later than corresponding teeth in the lower jaw.

The sequence in which the deciduous teeth are shed is given, and is the same for boys and girls.

Estimates of the interval between shedding deciduous teeth and the eruption of corresponding permanent teeth have been made. The interval is greatest for the molar teeth.

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A new "practical training" centre for mentally handicapped persons was opened at Acton Lodge, Isleworth, earlier this month. Mr. J. VAUGHAN-MORGAN, Parliamentary Secretary to the Ministry of Health, in congratulating the Middlesex County Council on their work in this field, said that in the country as a whole there were still 3,000 children and 5,000 adults suitable for special training who were not yet receiving it. This lack of suitable training facilities was also recently stressed by the Minister of Health, Mr. DENIS VOSPER, at the opening of a new occupational centre for mentally defective children at Mapperley, Notts, in May. "So far," said the Minister, "we have only found it possible to give priority to the needs of children. But there are already over 5,000 boys and girls over 16 who are reported by local health authorities to be suitable for, but are not receiving, senior training."