A Paper ON THE SIGNIFICANCE OF ELECTROCARDIOGRAMS OF THE LOW-VOLTAGE VARIETY

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Of recent years there has been a good deal of controversy on the significance of the low-voltage electrocardiogram. Some authorities consider that such tracings indicate changes in the heart muscle, whilst others deny that their occurrence is of any special significance.

REVIEW OF THE LITERATURE

The literature on the subject is not large. Almost without exception, tracings showing low-voltage changes in all three leads have alone been considered. Sprague and White¹ analysed fifty-seven cases, all curves having an excursion of not more than 5 mm. either side of the base-line. They found that the arteriosclerotic group was the commonest (thirty-four cases), ten of these having definite occlusion of the coronary arteries. Ten cases belonged to the hypothyroid group. The remaining thirteen included three cases in which syphilitic infection had been a marked feature. Finally, it was definitely stated that low-voltage curves were not found with normal hearts.

Willius and Killins² examined a large number of electrocardiograms, taking the same standard as above. They found low-voltage curves occurring in only 0.3 per cent. of all cases, but those showing associated graphic changes were excluded. Of the 140 cases ultimately studied, 32 per cent. had cardiac disease as the predominant feature. Of the remaining 68 per cent., the largest number occurred in patients with either diabetes or chronic nephritis.

Burnett and Piltz³ comment on the acceptance of a 5-mm. deflection as a standard for low-voltage curves, and suggest that excursions of a somewhat greater amplitude should be included in this category. They consider a number of cases that show deflections up to 8 mm., stating, however, that the smaller the excursion the greater its significance, especially in leads I and II. They conclude that the occurrence of low-voltage curves, even in the absence of demonstrable cardiac changes, may be considered as extremely suggestive of cardiac disease.

Speckman and Rich⁴ record a study of fifty cases, forty-nine of which showed clinical evidence of heart disease. The standard adopted was that the total deflection of the QRS complex did not exceed 5 mm. in any of the three leads. They state that the occurrence of such low-voltage changes is of serious prognostic import. Arteriosclerosis, with or without hypertension, was the chief aetiological factor. The total deaths recorded were thirty-six. Thirty-two of these patients died within six months of the time the first electrocardiogram showing low-voltage changes had been taken. Post-mortem examinations were performed on fourteen of the cases; ten of these showed some degree of sclerosis in the coronary arteries. On microscopical examination an abnormal myocardium was discovered in every case, some degree of fibrosis being the most usual finding.

CRITERIA OF PRESENT INVESTIGATION

Our work was undertaken in an attempt to determine two factors: (a) whether a low-voltage curve has any

clinical significance, and (b) whether this significance (if existing) varies in any way according to the lead in which it occurs.

All electrocardiograms examined were taken with standard instruments supplied by the Cambridge Scientific Instrument Company, Ltd.; immersion electrodes were used, except in the case of a few bed-ridden patients, where Kohn electrodes were substituted.

The standard usually accepted for a low-voltage electrocardiogram is an excursion of not more than 5 mm. either side of the base line. There appears to be, however, an obvious objection to such a standard. For example, an electrocardiogram showing an R wave 4 mm. high and an S wave 4 mm. in depth would fall into this category, whereas one having an R wave 6 mm. in height and no S wave would not, although it seems reasonable to consider that the latter tracing belongs more correctly to the low-voltage variety than the former. After consideration, it was agreed to include only such cases as showed 7 mm. or less between the top of the R wave and the bottom of the S wave. Should the tracing show only one of these waves, its height or depth must be 7 mm. or less.

TYPE OF CASE

The cases examined fall into two main categories: (1) those in which electrocardiograms show low-voltage tracings in leads I or II (or both); and (2) those in which electrocardiograms show definite low-voltage tracings in all leads. It was found that over 10 per cent. of electrocardiograms show low-voltage curves in lead III. It is obvious, therefore, that this condition is quite common, and cannot be considered abnormal. The other two classes of case will now be considered separately.

The First Type

Electrocardiograms taken during a period of two years were examined. All cases in which the clinical history and state of the patient were unknown were excluded; this reduced the number under consideration to 720. Of these, twenty showed low-voltage curves in all three leads, and will be considered later. The remaining 700 tracings were divided into three groups, in which (A) the cardiovascular system, after full examination, had been passed as normal; (B) the electrocardiogram was normal in all other respects, although the heart was affected; and (C) the heart was affected, the electrocardiogram being abnormal in other respects.

Group A.—In this the history was not suggestive of cardiac disease; the heart was normal clinically; and the electrocardiogram was normal in other respects. This group comprised 168 cases, of which ninety-six patients were male and seventy-two female. The following table shows the cases that enter the low-voltage category.

TABLE I

Height in Mm.			Age	Sex	Height in Mm.			Age	Sex
Lead—					Lead—				
I	II	III			I	II	III		
6	7	10	30	M	4	9	8	40	M
5	15	12	39	M	5	10	7	29	M
6	15	7	19	M	3	10	8	25	M
2	10	10	17	F	4	12	14	30	M
4	13	10	54	M	5	9	7	20	M
5	12	9	48	F	3	17	15	22	M
3	12	9	20	M	3	9	8	28	F
2	13	12	24	F	4	22	20	20	M
4	11	10	34	F	4	15	14	28	F
5	13	11	50	M	5	8	7	33	F
5	10	8	20	F	3	10	10	23	F
3	10	10	14	M	4	8	7	30	M
4	15	12	38	M	4	16	10	28	M

It will be seen that the low-voltage type of curve occurs almost exclusively in lead I. Only one case was found in lead II (0.6 per cent. of the total); this, showing a deflection of 7 mm., is only just included in the category. On the other hand, twenty-six cases (15.5 per cent.) showed low-voltage curves in lead I; of these patients seventeen were male and nine female; the average age was 29.

Group B.—In this the heart was affected clinically, and the electrocardiogram was normal in other respects. There were eighty-three cases in this group; six only (7 per cent.) had low-voltage changes, as shown in the following table:

TABLE II

Height in Mm.			Age	Sex	Clinical Diagnosis
Lead—					
I	II	III			
6	10	7	6	F	Mitral disease
2	13	10	11	F	" "
4	10	7	50	M	Myocardial degeneration
1	10	11	28	M	Exophthalmic goitre
3	22	20	22	M	Mitral disease
4	11	8	7	M	Rheumatic myocarditis

It will be seen that in no case was a low-voltage curve present in lead II, the changes being present exclusively in lead I. Taking groups A and B together, low-voltage changes were found in thirty-two cases out of 251 (12.7 per cent.) in lead I. In only one case were changes present in lead II (0.4 per cent.). This appears to be fairly good prima facie evidence that low-voltage changes occurring only in lead I are of little or no import.

Group C.—In this group the heart was affected and the electrocardiogram was abnormal in other respects. This forms the largest group, consisting of 449 cases. Of these, fifty-one (11.4 per cent.) showed low-voltage changes in either lead I or II, or in both leads. The following table summarizes the results found.

TABLE III

Case No.	Height in Mm.			Age	Sex	Physical Signs and Diagnosis	Electrocardiogram
	Lead—						
	I	II	III				
1	4	13	10	47	M	No abnormal physical signs	Left axis deviation
2	2	10	12	10	M	Mitral disease	Right axis deviation
3	2	12	15	50	M	Myocardial degeneration. Chronic bronchitis	Right axis deviation
4	5	16	14	38	M	No abnormal physical signs	Right axis deviation
5	3	15	18	6	F	Results of acute rheumatic carditis 1 year previously	Right axis deviation
6	4	9	12	12	M	Mitral stenosis	Right axis deviation
7	5	11	12	16	M	No abnormal physical signs	Right axis deviation
8	6	14	10	19	M	Exophthalmic goitre	Right axis deviation
9	4	9	9	25	F	Mitral stenosis	Auricular fibrillation. Right axis deviation
10	3	8	8	50	F	Myocardial degeneration	Auricular fibrillation
11	5	11	10	49	F	Myocardial degeneration	Auricular fibrillation
12	6	9	7	42	F	No abnormal physical signs except cardiac irregularity	Auricular fibrillation
13	4	9	6	48	F	No abnormal physical signs except cardiac irregularity	Auricular fibrillation
14	2	9	10	60	M	Myocardial degeneration	Auricular fibrillation. Left axis deviation
15	3	15	12	31	M	Bacterial endocarditis	Auricular fibrillation. QRS 1 and 2 broad
16	3	15	15	38	M	No abnormal physical signs	Auricular fibrillation
17	5	14	14	60	F	Myocardial degeneration and bronchitis	Auricular fibrillation. R2 notched

TABLE III (continued)

Case No.	Height in Min.			Age	Sex	Physical Signs and Diagnosis	Electrocardiogram
	Lead —						
	I	II	III				
18	5	14	12	46	F	No abnormal physical signs except cardiac irregularity	Auricular fibrillation
19	5	11	9	31	F	Mitral stenosis	Auricular fibrillation. Right axis deviation
20	4	8	7	49	F	Mitral stenosis	Auricular flutter
21	2	10	7	69	F	Mitral stenosis	Auricular flutter
22	4	8	4	30	M	Neurosis. No abnormal physical signs except premature beats	Premature beats
23	5	8	10	27	F	Mitral disease	Premature beats
24	1	9	9	40	M	First seen with complete heart-block; 3 months later had right branch-bundle block only. W.R. negative	Right branch-bundle block
25	4	10	8	50	M	Angina. Hyperpiesis. W.R. negative	Prolonged P-R interval. R2 notched. Left axis deviation
26	4	15	14	43	M	Slight cardiac enlargement	Right branch-bundle block
27	4	17	18	40	M	Exophthalmic goitre	T inverted in all leads
28	2	12	10	47	M	No abnormal physical signs	T2 inverted
29	3	12	12	59	M	Angina. W.R. negative	R2 notched. T2 inverted
30	5	15	10	60	M	Myocardial degeneration	T2 inverted
31	4	15	12	54	F	Myocardial degeneration. W.R. negative	T2 inverted
32	3	8	6	50	M	Myocardial degeneration	R1 and R2 slurred
33	12	2	10	50	F	No abnormal physical signs	Left axis deviation
34	10	7	13	55	F	No abnormal physical signs	Left axis deviation
35	8	4	10	45	M	Myocardial degeneration. Carcinoma of stomach	Left axis deviation
36	8	3	12	39	M	No abnormal physical signs	Left axis deviation
37	12	5	13	47	F	No abnormal physical signs. Menopause	Left axis deviation
38	12	6	7	60	F	No abnormal physical signs	Left axis deviation
39	8	5	7	11	M	No abnormal physical signs except premature beats	Premature beats
40	10	5	12	55	M	Myocardial degeneration	Left axis deviation. R2 slurred
41	15	5	8	40	M	Myocardial degeneration. Chronic bronchitis	Right axis deviation
42	10	5	8	36	M	No abnormal physical signs	Auricular fibrillation
43	9	5	12	37	M	Exophthalmic goitre	Auricular fibrillation
44	8	5	6	60	M	Myocardial degeneration	Gross changes in electrocardiogram
45	9	3	8	62	F	Myocardial degeneration	R2 notched
46	9	1	8	40	M	Angina. W.R. negative	R2 slurred
47	9	3	3	50	M	No abnormal physical signs	T2 inverted
48	10	1	12	41	M	No abnormal physical signs	R2 slurred. R1 notched. Left axis deviation
49	7	4	6	48	M	Myocardial degeneration	Left axis deviation
50	5	5	3	8	F	Convalescing from enteric fever	P-R interval 0.26 sec.
51	7	4	8	44	M	No abnormal physical signs	R2 notched

On a more detailed examination of the table it will be found that of the fifty-one cases recorded thirty-two show low-voltage changes in lead I only; sixteen in lead II only; and three in both leads I and II. Considering these latter three cases first (Nos. 49–51), one (No. 50) was found of a patient recovering from enteric fever. He recovered and left the hospital, but unfortunately cannot be traced. Of the other two cases, one patient (No. 49) was still living two years later, and apparently in fairly good health; the second (No. 51) cannot be traced. Of the thirty-two cases showing low-voltage changes in lead I only, it appears probable that the cardiac muscle was fairly sound in thirteen (Nos. 1, 2, 4–9, 19–23). The remaining nineteen showed either clinical or electrocardiographic evidence of myocardial damage (Nos. 3, 10–18, 24–32). With regard to the

cardiac lesion present, eight of the nineteen cases were diagnosed as myocardial degeneration, all but one showing other abnormalities in the electrocardiogram suggestive of muscle damage. Of the remaining eleven cases, six gave abnormal electrocardiograms as the sole evidence of heart disease (apart from irregularity of the heart beat). There were two cases of angina (one with marked hyperpnea); one of bacterial endocarditis; one of heart-block; and one of exophthalmic goitre. Of the remaining sixteen—those cases with low-voltage curves in lead II—it seems probable that the heart muscle was normal in seven (Nos. 33-39). The first six all showed some left axis deviation; the remaining one (No. 39), in which the condition of the heart muscle was perhaps more doubtful, showed premature beats. This suggests that no great significance can be given to the occurrence of a low-voltage curve in lead II, where left axis deviation is also present. The other nine cases (Nos. 40-48) showed definite additional evidence of myocardial damage.

The Second Type

We now come to the consideration of a number of cases in which low-voltage changes were found in all three leads. These tracings (thirty-eight in number) were collected from two sources. The first twenty were found in the course of examining the 720 electrocardiograms mentioned above. The remaining eighteen were discovered during the examination of 1,451 additional electrocardiograms; thirty-eight cases out of 2,171 gives a percentage of 1.75.

The following is a list of the cases, subdivided into two groups: (1) twenty-one patients who have died (Table IV); (2) and seventeen who are still living (Table V).

TABLE IV

Case No.	Patient	Age	Height in Mm.			Diagnosis	Duration of Life after Examination
			Lead—				
			I	II	III		
1	Female, A. B.	78	4	4	4	Coronary thrombosis	1 day
2	Male, J. D. K.	40	4	4	7	Coronary thrombosis	1 day
3	Male, S. L.	70	0	1	1	Stokes-Adams syndrome	48 hours
4	Male, B. S.	50	2	4	6	Myocardial degeneration. Arteriosclerosis. Acute heart failure	48 hours
5	Female, M. L.	38	1	4	5	Mitral stenosis. Auricular fibrillation. Hypostatic pneumonia	1 week
6	Female, K. H.	18	3	4	1	Acute rheumatic pancarditis	1 week
7	Male, P. C. C.	40	4	4	3	Myocardial degeneration. Arteriosclerosis +	Less than a month
8	Male, A. M.	45	6	6	3	Coronary thrombosis	Less than a month
9	Male, E. H.	50	2	4	3	Enlarged heart. Heart failure. W.R. positive. No post-mortem	Less than a month
10	Female, G. T.	61	2	2	1	Diabetes many years. Angina 3months. Coronary arteriosclerosis. Myocardial degeneration. Heart failure	2 months
11	Female	56	4	3	7	Diabetes. Myocardial degeneration	Less than 3 months
12	Male, A. R.	45	4	4	4	Myocardial degeneration	Less than 3 months
13	Male, C. A.	76	2	3	2	Myocardial degeneration. Arteriosclerosis. W.R. positive	Less than 6 months
14	Female, A. L. D.	64	4	5	3	Myocardial degeneration. Angina	Less than 6 months
15	Male, N. A. L.	50	2	4	3	Myocardial degeneration. W.R. negative	6 months
16	Male, C. C.	52	2	2	2	Myocardial degeneration.	9 months
17	Female, W. B.	64	4	5	3	Arteriosclerosis. Myocardial degeneration. Angina	9 months
18	Female, A. R.	62	6	6	6	Myocardial degeneration	Less than 1 year
19	Female, F. R.	30	1	2	4	Pain of anginal type. No definite abnormal physical signs	1 year
20	Male, C. R.	76	2	3	2	Arteriosclerosis. Myocardial degeneration. Syphilis 58 years ago	1 year
21	Male	71	5	5	2	Arteriosclerosis. Myocardial degeneration. Angina	14 months

TABLE V

Case No.	Patient	Age	Height in Mm.			Diagnosis	Patient Still Living After—	Condition when Last Seen
			Lead—					
			I	II	III			
1	Female, A. S.	65	5	3	5	Tachycardia and dyspnoea	2 months	Fairly fit
2	Female, C. C.	61	6	5	4	Anxiety state. No cardiac symptoms. B.P. 150/90	6 months	Doing well
3	Female, E. K.	55	2	4	3	Myocardial degeneration	1 year	Fairly fit
4	Male, J. N. R.	60	2	5	2	Coronary thrombosis	1 year	Quite well *E.C.G. 2/7/5
5	Male, D. G. F.	24	3	6	7	Obesity	1 year	Well
6	Male, W.A. L.	61	5	3	4	Chronic bronchitis. Myocardial degeneration. P-R 0.24 sec.	1 year	No change
7	Male, T. C.	43	7	7	4	Hypochondriasis. Vasomotor angina	14 months	Very fit
8	Male, R. B. W.	47	5	6	3	Long-standing bradycardia: pulse, 30-45. Syncopal attacks for 4 months following influenza	18 months	Doing well
9	Female, F. B.	50	3	5	7	Auricular fibrillation. Bronchitis	2 years	Fairly fit
10	Male, W. W.	58	5	5	2	Coronary thrombosis	2 years	Very well *E.C.G. 10/7/8
11	Male, J. H. M.	39	7	7	6	Post-influenza tachycardia. Vague precordial pain	2½ years	Quite well. No symptoms
12	Male, C. W.	16	1	5	5	Acute rheumatic carditis	3 years	Fairly fit. Mitral stenosis and pericardial adhesions
13	Male, H. S.	14	4	3	2	Acute rheumatic carditis	3 years	Very fit. Mitral disease
14	Male, J. C. W.	57	5	7	3	? Paroxysmal tachycardia	3 years	Fit. No symptoms
15	Male, A. W. H.	54	6	6	7	Coronary arteriosclerosis. Mild angina	3½ years	Fit. No pain for 2 years
16	Male, A. R.	56	5	5	2	Paroxysmal tachycardia, otherwise healthy	5 years	Excellent health
17	Male	79	7	7	7	Syncopal attacks	5 years	Very fit

* E.C.G. = electrocardiogram.

Of the thirty-eight patients examined, twenty-one had died within fifteen months, the average duration of life being four and a half months only; eighteen of these (47 per cent.) had died within the year. The remaining seventeen patients have been seen at periods up to five years after the initial electrocardiogram, the majority being in good health. These two classes of case appear at first sight to be somewhat irreconcilable. It is obvious that if 50 per cent. of patients showing low-voltage tracings are dead within the year the prognosis in such a case must be guarded; but it loses its real value unless one can say whether such a case will fall into the first or the second category. A consideration of the diagnosis in the two classes is helpful.

TABLE VI

Diagnosis	Class I (Table IV)		Class II (Table V)	
	Fatal Cases		Non-fatal Cases	
	No. of Cases	Percentage (approx.)	No. of Cases	Percentage (approx.)
Myocardial degeneration*	14	67	5	29
Coronary thrombosis ...	3	14	2	12
Angina ...	1	5	1	6
Acute rheumatic pancarditis ...	1	5	2	12
Chronic endocarditis ...	1	5	—	—
Cardiac enlargement? cause ...	1	5	—	—
Post-influenza tachycardia ...	—	—	2	12
Obesity ...	—	—	1	6
Anxiety state ...	—	—	1	6
Paroxysmal tachycardia ...	—	—	2	12
Tachycardia ...	—	—	1	6

* Including heart-blocks.

The outstanding point is seen under the heading "myocardial degeneration," the great majority of the cases falling into the fatal category. The five cases in group 2 were Nos. 3, 6, 9, 15, and 17, Nos. 15 and 17 only just coming into the category of low-voltage curves. On the other hand, all the fourteen cases in group 1 easily fall below the standard accepted for low-voltage tracings.

It seems reasonable to assume that the prognosis in the case of a patient who has symptoms of myocardial degeneration, and also shows a low-voltage curve in all leads, should be extremely guarded, as the great majority of such patients live a few months only. On the other hand, the prognosis, although still doubtful, is better in those cases in which cardiovascular degeneration is not suspected to be present to any marked degree. On the whole, the lower the voltage of the tracings the worse the prognosis, the average for the two groups being:

(1) Fatal (Table IV)			(2) Non-fatal (Table V)		
Lead ... I	II	III	Lead ... I	II	III
Average ... 3	3.76	3.45	Average... 4.57	5.24	4.3

CONCLUSIONS

1. Low-voltage curves occurring in lead I only are found as commonly in electrocardiograms of normal hearts as of abnormal ones. It is obvious, therefore, that no especial significance can be placed on its occurrence *per se*. When, however, the electrocardiogram is abnormal in other respects its presence may have some slight significance, as it is a fact that a large percentage of such cases showed evidence of fairly gross muscle damage.

2. With low-voltage changes occurring in lead II we may state that: (a) The first two groups, consisting of 251 cases, showed only one case coming into this category. Its presence, therefore, in an otherwise normal electrocardiogram would be unusual, and possibly suggestive of muscle damage. (b) It occurs relatively frequently in tracings showing left axis deviation. Here it cannot be considered either as abnormal or as having any special significance. (c) Associated with changes in the electrocardiogram other than left axis deviation it must be considered to be abnormal, and strongly to suggest myocardial damage.

3. Low-voltage curves occurring in lead III only were very commonly found, and cannot be regarded as having any especial significance.

4. Low-voltage changes occurring in all three leads were found in 1.75 per cent. of the total electrocardiograms examined. In cases showing evidence of cardiovascular degeneration the occurrence of such a tracing is significant, and justifies a bad prognosis. Exceptions do occur, but the great majority of these patients die in a comparatively short time.

Finally, it should be noted that low-voltage curves (in lead II only or in all three leads) are particularly likely to occur in cases of cardiovascular degeneration, and their presence usually indicates a poor prognosis. The significance of such curves is of no great import unless considered in conjunction with the other factors of the patient's case; if this is done their occurrence may prove of great value in giving an accurate prognosis.

REFERENCES

- ¹ Sprague, H. B., and White, P. D.: *Journ. Clin. Invest.*, Baltimore, 1926-7.
- ² Willis, F. A., and Killins, W. A.: *Arch. Int. Med.*, 1927, xl, 332.
- ³ Burnett, C. T., and Piltz, A. F.: *Amer. Heart Journ.*, 1927, ii, 649.
- ⁴ Speckman, R. N., and Rich, M. L.: *Journ. Lab. and Clin. Med.*, November, 1931, p. 165.

EFFECT OF CERTAIN PHYSICAL FACTORS ON THE MENTAL CAPACITY OF SCHOOL CHILDREN*

SYNOPSIS OF PRELIMINARY REPORT

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The children in this investigation were those attending the schools in the burghs of Falkirk and Stirling; the population is mostly industrial, as shown by the classification of parents' occupation—manual 85.8 per cent., sedentary 11.1 per cent., professional 3.1 per cent. Two groups that were medically examined during 1931 were taken. The first comprised 479 boys and 476 girls of approximately 9 years, and the second 346 boys and 337 girls of approximately 13 years of age. Each group was subdivided according to the mental capacity of its members—and by mental capacity is meant the sum of intelligence and ability to acquire knowledge—into four: advanced, normal, retarded, and very retarded.

In ascertaining to which division a child belonged two factors were taken into consideration: first, the child's fitness to do the work of its school class, and secondly, the correct age for that class. The first was estimated by the teachers and head masters, and in regard to the second there was a nominal age of entry for each class, and an allowance of six months was made on either side of this as the limit of normality. The percentage numbers resulting in each division approximated closely to the figures found by the Royal Commission on Physical Training (Scotland). A study of the figures shows that there is a tendency for the girls to find their way into relatively more advanced classes than the boys.

Each division was then compared as regards attendance at school, nutrition (judged by height and weight), employment out of school hours, home environment (judged by size of house, persons per room, occupation of parent, cleanliness, and clothing of child), and physical abnormalities.

Attendance.—Loss of attendance during any part of the school career was counted, and three classes of children were included: (a) those going to school late; (b) those changing school during their "primary" career; (c) "irregular attenders," in the commonly accepted sense. In the third class it was found impossible to fix any definite standard which would imply irregularity, and reliance was placed on the teacher's estimate. It is, of course, accepted that the greatest amount of irregularity is bound to occur during the early years of the school career, and the figures for the 9 years group show that the position of the child in school suffers materially during that period. By the time the child is 13 there has been an opportunity to make up the lost ground, and the irregular attenders are more evenly spread over the four divisions, although the "normal" children still show the smallest percentage of irregularity. The striking factors are that there is greater irregularity among children from very small houses and from large houses, and that there is a larger percentage of irregular attenders among girls than among boys, especially in the 9 years group. Children of professional people are more irregular in attendance than those of manual workers, and the children of sedentary workers are the best attenders. It is evident, therefore, that a child's position in school cannot be taken *alone* as a reliable index of its mental capacity, especially in the earlier years. In order to avoid this fallacy a separate study of the regular attenders was made.

Nutrition.—The factors dealt with here—namely, height and weight—have to be judged in relation to the age and sex of the children concerned. With the exception of the 13 years "advanced" girls there was a steady decline in both height and weight from the "advanced" to the "very retarded."

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