Adolescent education in county boroughs and industrial districts, and the place of physics in the reorganised schools

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"ADOLESCENT EDUCATION IN COUNTY BOROUGHS AND INDUSTRIAL DISTRICTS, AND THE PLACE OF PHYSICS IN THE REORGANISED SCHOOLS".

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INTRODUCTION.

Interest in education is universal; yet few subjects suffer so severely from rambling argument and unsatisfactory theory as this vital branch of human endeavour. Too often, educational theory is based on vague impressions rather than sound scientific investigation, while projected reforms are the outcome of purely personal opinion. If, then, from a study of educational theory and from experiments in practical teaching, general principles of advance can be formulated, the work is perhaps not in vain and something more may be added to the structure of educational philosophy and the body of educational policy.

In limiting this thesis to County Boroughs and Industrial Districts, the intention is to visualise the formation of area and provincial authorities[1] rather than to deal minutely with particular County Boroughs and isolated urban districts. It has long been realised that the efficiency of progressive education is seriously impaired by the exercise of powers for elementary and higher education by different authorities in Part III areas, and while legislative action has made it possible for districts to combine under one authority, individual authorities are loth to submerge their autonomy, and a homogeneous areaunder one authority is still an ideal. Yet "unity of control within a single area is indispensable to any ordered progress, and, if a co-ordinated post-primary system is ever to be created, it must involve a readjustment of administrative boundaries and the resting of all power within them in a single authority."[2]

This division of control is not only a drag on reorganisation but a barrier to better co-operation between education and industry, and has been deplored in the numerous reports on

1. Compare the Report of the Education of the Adolescent P. 181.
2. The Next Step in National Education — Haldane P. 196.

this subject in the last few years. In dealing with Regional and National Co-operation the Report on Education for Industry and Commerce, reads "But however much may have been done to promote co-operation in the ways already indicated, it is clear that local education authorities are often working under a distinct handicap owing to the fact that, while the most important industries of the country have become highly organised on a national or regional basis, the administration of technical education has remained local", and again: "It is clear that advanced instruction can best and most cheaply be provided in relation to industrial districts which are usually if not always wider than the areas administered by these local authorities"! More definite action cannot be long delayed.

It is proposed, therefore, to consider the teaching of physics in relation to those areas where there is a large density of population and where the people are associated with manufacturing rather than agricultural pursuits.

As opposed to the specialist, the teacher is faced with the difficulty involved by the psychological element. From the point of view of the former, any subject may be reduced to a body of abstract lines of thought but in the case of the latter, the intrusion of the human element is not only an important, but perhaps the essential factor and the intrinsic interest of the subject itself, must yield to the interests of the child, the logical order of the subject to the psychological demands of the pupil. Before, therefore, attempting to consider Physics as a school subject, it is of primary importance to examine the main groups into which children are being divided, for though it is realised that the individual must not be lost in the group, a study of the group is vital to the proper understanding of the individual.

1. Education for Industry and Commerce P.39.

How far then are existing types of schools the outcome of tradition and spasmodic efforts to obtain a sound education, and what general principles determine the type of school at which a child will be educated? To what extent do the present schools satisfy a definite need? what changes are probable or desirable? Is the curriculum of the various schools suitable and what is the place of science and physics in the schools?.

It is not always possible to view contemporary events in their true perspective, but there can be little doubt that the Report of the Consultative Committee on the Education of the Adolescent in 1926 is a landmark in educational progress. This report, the outcome of two years research by some of the most prominent educationalists of the day, is searching in its examination and definite in its conclusions; so much so that there is a danger of regarding the report as absolute and incontrovertible. But to quote the report itself: "Progress must necessarily be tentative and experimental but the objective - a universal system of post primary education - should be held clearly in view, and the measures necessary to attain it should go steadily forward".

It must be remembered, moreover that by the terms of the reference - 'to consider and report upon the organisation objective and curriculum of courses of study suitable for children who will remain in full time attendance at schools, other than Secondary schools, up to the age of 15"...- the Hadow Committee considered not all children during adolescence, but were more concerned with the marking time in elementary schools after 11+. Reorganisation to be effective must include all adolescent children, and, while it may have been policy to exclude secondary education as a whole, there can be little doubt that the value of the report would be enhanced

if the Committee had been given a free hand, and all types of higher education and their bearing on the problem had been discussed. Furthermore the Committee surveyed the country as a whole rather than particular districts where more homogeneous conditions make more detailed schemes possible. In this thesis such restrictions are neither necessary nor advisable so it is intended to deal with all children in Industrial districts during the age period of eleven to sixteen years.

Whether the age of 11+ is chosen as marking that fundamental change in the whole physical and mental structure which is termed adolescence, that 'tide which rises in the veins of youth'; or whether as Burt pointed out the differences in mental ability become so definite at this age as to render it inexpedient and wasteful to teach children without subdivision, there is unity of opinion in that there should be a clean cut at 11+.

"There was indeed, something like unanimity among our witnesses as to the desirability of treating the age of 11 to 12 as the beginning of a new phase in education; presenting distinctive problems of its own and requiring a fresh departure in educational methods and organisation in order to solve them".[1]

The upper limit of full time education, involving as it does so many economic as well as educational factors, has always been the subject of much controversy.

The balance of education for individual development and the necessity of training to earn a livelihood will always be a fundamental problem in educational philosophy and all that may be said is that the age of 16 represents the present day ideal. Thus, in secondary education, 16 years is recognised

1. The Report on the Education of the Adolescent P. 72.

as the age before which a pupil must not be withdrawn from school; Technical education, too, is based on a general education up to this age, while an almost universal higher education up to sixteen was one of the main findings of the Departmental Committee on Free Places in 1920. In Industry also there is a growing recognition that after this age the employee should have definite standing.

"It should be remembered that there is a distinct tendency in certain occupations to encourage a longer period of full time schooling and a later age of entry into employment - - -. It is important to view this stage of education from 11 to 16 as a whole and not in watertight compartments".[1]

In the rapidly changing conditions of the last few years employers have turned more and more to education, realising slowly that their most valuable raw material comes from the schools; yet the educational system proves frequently incomprehensible and novel. The old 'standard' has no meaning, new schools have arisen with their forms and years and bias. The new nomenclature of the Hadow Report has added to the confusion. The Malcolm Committee state: 'We feel that employers and indeed, the general public have some reason to complain, as they do, of the complications of educational nomenclature; and we agree with the National Federation of Employers' Organisation in thinking that the issue of a brief handbook descriptive of the educational system is essential to the 'education' of all concerned".[2]

A survey of existing conditions must be the basis of further development.

1. Education for Industry & Commerce. P.12.
2. Report of the Committee on Education and Industry P.10.

CHAPTER I.

The Existing Schools.

Since 1870 the majority of the children have been educated in elementary schools. "An Elementary School is defined by Section 170(1) of the Education Act 1921, as a school, "at which elementary education is the principal part of the education there given". It is, however, provided in Section 20 of the Act that courses of advanced instruction shall be provided for other children".

The name elementary covers the various schools which arose in the 19th century for the general education of the masses. These schools In industrial areas, are not entirely in the hands of the Local Education authorities, for various religious bodies still retain a measure of control over non-provided schools. Elementary schools provide free compulsory education - compulsory unless 'efficient' instruction is obtained elsewhere - from 5 years to the end of the term in which the 14th birthday is reached. These age-limits may be adjusted by byelaws. In the more densely populated areas the schools are divided into departments; infants five years to 7+ ; Juniors - which in spite of some criticism it is thought advisible to retain - from 7+ to eleven years; and boys' and girls' departments, senior departments, from eleven years to 14+ .

In the latter half of the 19th century under the system of payment by results, a more or less rigid curriculum was laid down, at present the Code only specifies the aim of these schools in general terms - "the secular instruction in a school or centre must be in accordance with a suitable curriculum and syllabus framed with due regard to the organisation and circumstances of the school or schools concerned"[1] - and the wishes of the Board of Education are put forward in the Suggestions to Teachers, in which it is suggested: "The

[1] Code 1926 P.10.

purpose of the Public Elementary School is to form and strengthen the character and to develop the intelligence of the children entrusted to it, and to make the best use of the school years available in assisting both girls and boys, according to their different needs, to fit themselves practically as well as intellectually for the work of life".[1]

Even before the report of the Hadow Committee there had been a growing tendency to regroup the children at 11+, the report gave impetus to the movement, and after this age the pupils are associated with one or other of four main types of school, though the nomenclature and method of selection varies in different localities. The types of school are:-

(i) Secondary, Grammar, Modern (Leeds) or Intermediate (Wales) Schools.

(ii) Junior Technical Schools - the term which also includes Junior Commercial Schools & Junior Art Departments.

(iii) Central, Selective, Modern or Middle Schools (West Riding)

(iv) Senior, Non Selective or Intermediate Schools, (Durham)

and on leaving these schools before sixteen

(v) Evening Classes and Day Continuation Schools.

In rural areas and in some industrial districts selected pupils are grouped in Senior Classes in the same school. The Report however advocated separate departments.

"In our view, the balance of advantage is in most cases (though doubtless for a long time to come there will be exceptions) in favour of emphasizing the fact that a new stage in education begins at 11+ by transferring as many

1. Handbook of Suggestions for Teachers. P.8.

children as possible at that age, not merely to a different type of teaching within the same school, but to another institution with a distinctive staff and organised definitely for post primary education."[1]

At the age of 11+, either by a competitive or a qualifying examination, children who are 'capable of profiting' are transferred to the secondary school type. The rapid development of these schools is one of the most striking features of the 20th. century. By the Education Act of 1902 the local authorities were to consider the needs of their area and take what measures they thought desirable, while in 1918 adequate provision of secondary education became a duty. After 1902 many of the old Higher Grade Schools and Organised Science Schools were made to conform with the regulations for secondary schools, while the majority of the old Grammar School foundations were transferred to the control of the local authority.

A secondary school is "a school for pupils who intend to remain for at least four years and up to at least the age of 16. It must provide a progressive course of general education of a kind and amount suited to an age range at least from 12 to 17".[2]

Fees are charged 'but not less than 25% of the total number of admissions in the previous year must be offered to pupils who have been in attendance at elementary schools for at least two years immediately before entering the Secondary School'.[3] The total number of free places must not exceed 50% of the admissions of the previous year without the consent of the Board. The curriculum is defined in more detail than for elementary schools - except with previous permission from the Board, adequate provision must be made for

1. Report on the Education of the Adolescent P. 80
2. Regulations for Secondary Schools 1930. N°2.b.
3. Regulations for Secondary Schools 1930 P. 13, 14, 15.

TABLE I.

	Secondary School	Elementary Senior School.
(a) Space. In General Planning.	Twice as much as Elementary.	
Space per child in Classrooms	16–18 sq. ft.	12 sq. ft.
Space per child in School Hall.	6 square feet.	3·5 square feet.
(b) Cost.		
Initial cost of buildings per place ('1930')	£80–£120	£35–£40
Cost of furnishing per place.	£10.	£2.
Cost per pupil per annum.	£26-10.*	£12-5+

* Board of Education List 65.

\+ Board of Education List 43.

instruction in the English language & and literature, at least one foreign language other than English, Geography, history, mathematics, science, drawing, singing, manual instruction in the case of boys, domestic subjects in the case of girls, physical exercise and for organised games"[1].

The course of study is supposed to last until at least the age of 16 when School Certificate Examination is taken, and though this intention is not yet fully realised the proportion of pupils who remain to that or a higher age is steadily increasing. In recent years there has been a generous provision of advanced courses for pupils who continue their education until 18, and a system of State Scholarships has been instituted. To be recognised as 'efficient', secondary schools must be provided much more lavishly than is considered necessary in the case of elementary education, not only with buildings and general accommodation but with playing fields, apparatus and staffing. (Table I.) These schools are administered under regulations for Higher Education.

There has been developing since 1907 another type of school which aims at giving a pretechnical training for future employment in industry, commerce, art and domestic work. In 1913 definite regulations were issued for these schools under conditions for Technical Education. These schools are to prepare pupils for artisan or other industrial employment by a course of instruction which should last two and not more than three years. The course is to be a whole time one of not less than 30 hours a week and normally is to be planned for pupils leaving the elementary schools at 12 - 14. A proportion of the staff must have works experience. The schools are to be formed only when there is some certainty that the pupils will be absorbed locally in the specific industry for which the school is designed to feed. Selection

1. Regulations for Secondary Schools 1930. P7.

for these schools is by examination which is often used both as an entrance examination and also used as a basis for the award of scholarships. The examination is taken at 13+ by candidates from secondary central and elementary schools, but in practice there is little transferred from secondary and central schools at this age. Fees may be charged which vary from nothing (in Middlesborough) to six pounds a term (in Hull) Little has been done to provide new buildings for these schools which are usually housed in the Senior Technical College or in adapted buildings. The Regulations for Junior Technical schools now include under very similar arrangements Junior Commercial Schools and Junior Art Departments.

Another group of the more able children who for financial or other reasons do not intend to stay at school until 16 or who have not reached a sufficiently high standard in the Scholarship examinations may at 11+ be transferred to the Central School. These schools are not all new for many have developed from the Higher Grade and Higher Elementary Schools of the beginning. They are established with the view of providing, for specially selected boys and girls a general four years course of instruction with a definite commercial or industrial bias. 'At every stage of development it has been the general tendency of the national system of elementary education to throw-up experiments in post primary education. Though such experiments have again and again been curtailed or rendered difficult by legislative or administrative action, they have persistently reappeared in various forms. This fact in itself seems to indicate the half conscious striving of a highly industrialised society to evolve a type of school analogous to, and yet distinct from the secondary school and providing an education designed to fit boys and girls to

enter the various branches of industry commerce and agriculture at the age of 15".[1]

Central Schools are under the control of the authority for elementary education and are recognised under Section 20 of the Education Act 1921.

Since 1911 and 1912 these schools have been a distinctive feature of the educational organisation of London and Manchester, and the purpose and growth of the schools can best be gained from an account in the Handbook of the London County Council.[2]

"The L.C.C. from 1906 onwards considered ... that the organisation which produced at the top of each senior department of an elementary school a class composed of elements of varying ability and attainments under the charge of even a well qualified teacher should in a great urban area ... be replaced by a system which would collect the abler children from the senior tops into one organisation under a selected staff. This would ensure more homogeneous classes both in the new school and in the contributory departments and as a result, more effective work ... the problem was gradually reduced to the question of providing a means of education for those who had not been able enough to secure secondary education; for those who had reached the end of the elementary curriculum before their fourteenth year; for those whose parents wanted them to remain a year or two longer."

"All the Central Schools in the London area from their inception in 1911 have had a definite bias, either commercial or industrial and in some cases both. The general education provided for all pupils comprises English, mathematics, history, geography, art, practical science, music, physical exercise, together with handwork for boys and needlework and

1. Report on the Education of the Adolescent P. 34.
2. London Education Service. P. 57-64.

domestic science for girls. To these subjects is added in all schools with a commercial bias and in some schools with an industrial bias, a modern language,usually French. After two years a bias is introduced. In the schools with a commercial bias shorthand and book-keeping are introduced in the third year and typewriting and office routine in the fourth. To make room for these additional subjects some of those taught in the earlier years are discontinued. Boys usually drop handwork or science or both; girls drop music, cookery and laundry practice. In boys' central schools with an industrial bias special attention is devoted to practical mathematics, practical science and handwork. Stress is also laid on technical drawing which includes designing, scale drawing, tracing and the making of blue prints. In girls' central schools with an industrial bias more time is given in the last year of the course to needlework, art, science and domestic subjects. A certain degree of bias is also given to the instruction in the ordinary subjects of the curriculum".

In pursuance of the policy suggested by the Hadow Report similar central, selective central, or modern c schools are being developed. All are characterised by a similar bias of the curriculum; in many cases a third branch, an academic branch has been added.

School children who are not transferred to any of these three types of school, continue to attend the elementary school until 14+ and it was largely the unsatisfactory state of the education of these children which led to the investigations of the Consultative Committee in 1926. In recent years the tendency in Industrial areas has been to group these children from 11+ to 14+ in Senior Departments and attempt with varying success a similar type of syllabus to the Central

Schools. The provision of separate selective Central Schools is by no means universal many authorities e.g. Birkenhead and Rutland County, prefering to transfer all children reaching a certain standard, Standard V. to Non-selective Central Schools, and to group the children according to their ability in 'parallel streams' throughout the school. The curriculum is varied to suit the ability of the children but in the main it approximates to the curriculum of the Central School.

By far the greater part of the school children finish their full time education at 14+, and facilities are offered to them to continue their education at Evening classes and to a very limited extent at Day Continuation Schools. The Evening Classes are generally conducted on the premises of the elementary schools from 7 p.m. to 9 or 9.30 p.m. Small fees - perhaps half-a-crown per session - are often charged but numerous schemes provide that children passing directly from the elementary schools are admitted free. The curriculum in this type of education is a general two years course - a group course - in English, Mathematics and drawing, but frequently some commercial work, book-keeping and shorthand, is added.

The Education Act of 1918 made provision for the formation of Day Continuation Schools. These schools were to be part time schools for young persons between 14 and 16 years of age, who were to attend between 8 a.m. and 7 p.m. for 280 hours a year. Later the scope of the schools was to be extended, the age of exemption becoming 18 and the hours, 320 a year. The curriculum was to be a suitable course of 'study, instruction, and physical training' and no fees were to be charged.

As the outcome of this Act many schools were formed

both by local education authorities and private firms, in London thirty three of these schools were provided, and attendance of boys and girls of 14 to 16 was enforced. These sections of the Act, however, were never put into force on a national scale. In London "the establishment of the schools coincided with a period of acute general unemployment and financial anxiety. The Council, therefore, asked the Board of Education to release them from a statutory obligation which placed London at a disadvantage as compared with other local authorities. The schools ceased to work on a compulsory basis in July 1922. In their stead twelve voluntary day continuation schools have been opened one of which is a non-provided school." [1] Rugby persisted with the schools, and there Compulsory Day Continuation Schools are still in force. The curriculum of the schools was mostly of a general character but in some cases the work was vocational.

But before proceeding to formulate from an examination of the merits and demerits of the existing system, the probable lines of future advance, if education is to be based upon the best interests of the child and not upon purely financial considerations; it is well to enquire into the proportion of the children which is being educated in the various groups.

1. London Education Service. P112.

CHAPTER II

A Statistical Survey of Adolescent Education, 1925-1930.

TABLE 2. The Distribution of School Population in Eng. and Wales, 1924 — 1925.

Age	Estimated Population	Elementary Schools	Secondary Schools	Special Schools	Junior Technical Schools.	Day Continuation Schools	Part Time Technical	Unaccounted for.
11–12	716,742	638,645	28,617	5,535	98		176.	46,271
12–13	713,398	604,887	54,807	6,068	1232		622.	45,782
13–14	703,172	581,416	63,156	5,840	4036		13,826.	47,724
14–15	708,303	154,483	62,947	4,164	4297	18,315.	114,384.	348,000
15–16.	720,787	10,093.	55,450	3,040	2074		87,139.	565,000.

The figures are taken from the Statistics of the Annual Report of the Board of Education

The following statistical survey deals with the education of adolescent children in England and Wales between the school year ending in April 1925 and that ending in 1930.

If the distribution of school children for the year 1924 to 1925 be considered (Table 2,) it is seen that between 11 & 14 the difference between the estimated school population and the children accounted for in the National system is about 46,000 per age group, thus for the five years the total number is about 230,000. While this difference in part represents the error in estimating the school population it also includes the children who are educated at private schools, for example, 62,067 children are in 'efficient' secondary and preparatory schools that are not on the grant list.

For the age-groups 11 to 16 the number of children accounted for, including the 230,000 previously considered, is 2,730,000 to the nearest 1000; the estimated school population 11 - 16 is 3,562,000 thus 832,000 children are after 14+ not traceable. These children representing 23.5% of the total number of children between 11 and 16 and 57% of the children 14 - 16 are not in any way associated with the national system of education after leaving school at 14+. From the successive Reports of the Board of Education similar results have been calculated and the full survey is given in Table 3. In Table 4 the number of children in the various groups has been expressed as a percentage of the estimated school population 11 - 16 for the particular year. These percentages have been graphed for the various years.

It should be noted

(1) that in the years 1927 - 1928 and 1928 - 1929 the Board used the same figure as in 1925 - 1926 for the

TABLE 3. THE DISTRIBUTION OF ADOLESCENT CHILDREN IN DIFFERENT TYPES OF SCHOOLS 1924-1930.

I. SECONDARY AND JUNIOR TECHNICAL SCHOOLS.

YEAR.	ESTIMATED SCHOOL POPULATION. (11 - 16.)	NUMBER OF CHILDREN. (11—16) IN SECONDARY SCHOOLS.	% OF TOTAL Nº OF CHILDREN. (11-16).	IN JUNIOR TECHNICAL SCHOOLS.	% of Total.
24 -25	3,562, 402	264, 977	7·0	11, 737	.30
25 -26	3,529, 303	272, 329.	7·7	12, 462	·35
26 - 27	3461, 145	281, 752	8·1	20, 372	·59
27 - 28	3,343, 000. +	288, 724	8·7	22, 480.	.67
28 - 29	3,147 000 +	292, 463	9·3	20, 418.	.63
29 -30.	3,028, 580.	293, 850	9·7.	21, 685.	·72.

II. ELEMENTARY SCHOOLS.

YEAR.	ESTIMATED. SCHOOL POPULATION (11-16)	NUMBER OF CHILDREN (11—16) IN SENIOR SCHOOLS. (REORGANISED.)	%	IN ELEMENTARY SCHOOLS.	%	IN SPECIAL SCHOOLS.	%
1924 -25	3562, 402	98,000	2·7	1, 866, 277	52·4	24,647	·70
1925 -26	3529, 303	155,469	4·4	1,837, 000	52·0	45,261. (Allayes.)	
1926 -27	3461, 145.	163,536	4·9	1,763,105.	51·0	26,211	·75
1927 -28	3,343, 000 +	174, 574	5·2	1,667,931	49·8	26,182	·78
1928 -29	3147 000 +	209, 899	6·7	1455, 189	46·2	24, 643	·90
1929 -30.	3028 580.	238, 681.	7·9	1,323, 268.	43·6	23, 743	·79.

III. TECHNICAL SCHOOLS.

YEAR.	ESTIMATED SCHOOL POPULATION (11-16)	NUMBER OF CHILDREN (11—16) IN DAY CONTINUATION SCHOOLS.	%	IN DAY TECHNICAL SCHOOLS	%	IN PART TIME TECHNICAL SCHOOLS.	%
924 -25	3,562, 402	18, 315	·50	—		216, 147.	6·1
1925 -26	3529, 303	18, 922	·54	—		219, 056.	6·2
1926 - 27	3461, 145.	19, 033	·52	1, 801	·06	221, 165	6·4
1927 - 28	3, 343, 000 +	17, 515.	·51	2196	·06	231, 478.	6·9
1928 - 29	3, 147, 000 +	15, 475.	·48	2682	·08	238 860	7·5
1929 - 30	3, 028, 580.	15, 143	·50.	3522.	·10	234, 088	7·9.

YEAR.	ESTIMATED SCHOOL POPULATION (11-16	UNACCOUNTED FOR. (NOT IN THE NATIONAL) SYSTEM AFTER 14+.	%
924 - 25	3562, 402	832, 000	23·0
1925 - 26	3529, 303	770,000	22·0
1926 - 27	3461 145	764,000	22·1
1927 - 28	3343000+	735, 000.	22·0
1928 - 29	3,147000+	692, 000	22·0
1929 - 30.	3, 028, 580	670, 000.	22·1.

@ In the age groups 11-14 some 30-40,000 children are not accounted for. Many of these are in Private Schools. For the age groups 11-16 200,000 has been reckoned.

The figures are taken from the Annual Reports of the Board of Education 1924 - 1931.

+. These figures have been corrected.

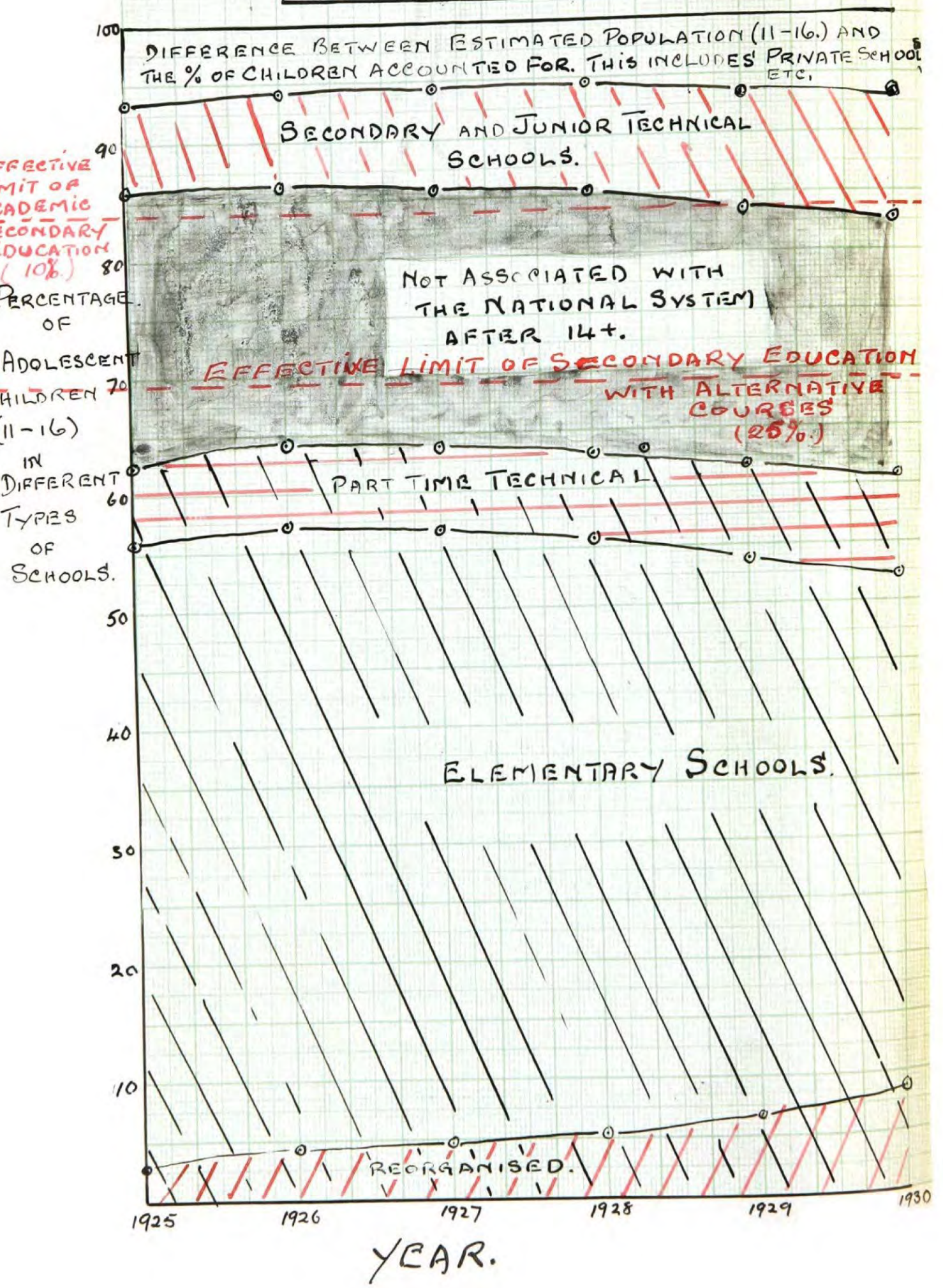
TABLE 4.

PERCENTAGES OF THE TOTAL NUMBER OF ADOLESCENT CHILDREN (11–16) IN DIFFERENT TYPES OF SCHOOLS 1925 – 1930 (ENGLAND AND WALES.)

SCHOOLS.	PERCENTAGES OF THE TOTAL NO. OF ADOLESCENT CHILDREN (11–16) FOR YEARS ENDING.					
	1925	1926	1927	1928	1929	1930.
SECONDARY	7·0	7·7	8·1	8·7	9·3	9·7
JUNIOR TECHNICAL.	·3	·35	·59	·67	·63	·72.
TOTAL.	7·3%	8·05%	8·69%	9·37%	9·93%	10·42%
SENIOR. (Reorganised.)	2·7	4·4	4·9	5·2	6·7	7·9
ELEMENTARY	52·4	52·0	51·0	49·8	46·2	43·6
SPECIAL.	·7	·8	·75	·78	·9	·8.
TOTAL.	55·8%	57·2%	56·65%	55·78%	53·8%	52·3%
DAY CONTINUATION	·5	·54	·52	·51	·48	·5.
DAY TECHNICAL.	—	·06	·06	·06	·08	·1
PART-TIME TECHNICAL.	6·1	6·3	6·4	6·9	7·5	7·9.
TOTAL.	6·6%	6·9%	6·98%	7·74%	8·06%	8·5%
UNACCOUNTED FOR.	23·5%	22·0%	22·1%	22·0%	22·0%	22·1%
TOTAL	93·2	94·2	94·3	94·6	93·8	93·3
PRIVATE SCHOOLS ETC.	6·8	5·8	5·7	5·4	6·2	6·7.

DIAGRAM I.

THE GROWTH OF DIFFERENT TYPES OF EDUCATION 1925-1930.



estimated school population. It is in these years that the low birth rate in 1916 - 1918 affects the 11 - 16 age-group. Thus the estimated school population has been corrected on the assumption that the number of children unaccounted for is approximately the same as the two previous years and the succeeding year namely 23 per cent.

(2) The figures for the number of children in reorganised schools before 1928 are given under the heading of Reorganisation in the body of the report.

(3) In considering the figures for re-organisation the footnote in the Reports of the Board must be borne in mind, viz, that in rural areas the establishment of separate departments is often impracticable and reorganisation has been effected by Senior Classes, some 100,000 children receive advanced instruction in this manner.

The diagram on the opposite page shows very clearly the fundamental problems which must engage the attention of educational reformers during the next decade.

In the first place how far shall the facilities for the present type of secondary education with its favoured conditions of accommodation, playing fields etc, be extended and if any marked extension is decided upon what changes in curriculum are advisible or necessary?.

Secondly what provision, either by increasing the school leaving age, by continuation school or by an extension of evening work should be made for the children who after leaving school at 14+ receive no further recognised education'?

And thirdly how far do the types of schools suggested by the First Hadow Report solve the difficulties of adolescent education? With this last and most vital problem of reorganisation of elementary education, may be combined the further enquiry as to what steps should be taken to hasten general

re-organisation and what kind of curriculum is most suited to the various schools. Already part of the curriculum has been surveyed and two valuable reports on the position of geography and French have been issued; without doubt the teaching of other subjects in these schools will be fully investigated.

CHAPTER III

Bias in the Curriculum.

An examination of the various experiments in the education of adolescent children shows without exception, that bearing in mind the great diversity of the children's minds, a diversity at least as great as that of their bodies, the fundamental considerations are, firstly, the type of curriculum most suited to the development of these capabilities and since education must be framed to fit the pupil into the social order, the degree to which the curriculum shall be influenced by the probable future vocation of the pupil; and secondly, granting that a differentiation of the curriculum is necessary which children are most capable of profiting by the different types of schools. Before dealing, therefore, with the broad problems suggested by the consideration of the statistical aspect of the question it would be well to discuss at more length this question of bias in the curriculum.

Before the age of machinery the problem of fitting the child to take his place in organised society created little difficulty, no artificial environment was needed, and the child grew up participating more and more in adult life by performing the simpler tasks which fell to his lot. As civilisation became more complex the Gild system of the 12th to the 15th century flourished. The Gilds jealous of the reputation of their crafts maintained a high standard, and the youths were instructed by a master in the 'art & mystery' of the crafts. The masters, too, were compelled by law to teach their apprentices 'reading, writing and their Troy weight table'. Since the Industrial Revolution, however, the order of civilisation has been rapidly changing. Gone are the old gilds with their conditions of apprenticeship, journeymen and master, the worker has changed from a craftsman to an operative; the pride in the completed article is lost and instead of a knowledge

of the whole method of manufacture, the raw material, the process, and the production, the worker is more and more restricted to a particular section of the work.

"In those industries," reads the Report on apprenticeship, "in which great specialisation of process and of product has become possible, the advance made in the perfection of mechanical methods and in the use of tools of precision has had the effect of introducing what may almost be described as a new class of worker - the winder of automatic or semi-automatic machines - many of whom are trained to a certain degree of skill by means of a rather vague and indefinite system of learnership, or by a simple process of up grading"[1].

The educational system must meet these changes, a new environment must be created and the gap between school and vocation must be bridged.

Nor have the changes been confined to Industry and Commerce, education itself has developed. The Newcastle Commission in 1856 when education was as yet in its infancy in England, found that the methods of teaching even of the comparatively few children who were being educated was inefficient and the need as Lowe realised was for a general grounding in the 3 R's, for these were the foundations of education. But methods of instruction have so far developed that by .11t the foundations have been truly laid, and at this age, today, attention must be given to the structure to be built on these foundations.

'So long as the curriculum consisted mainly of the 3 Rs the emphasis was all on discipline, thoroughness, and concentration. But now we have become concerned about the enrichment of life, our talk runs to such topics as interest purposeful activity and knowledge of the world we live in'[2].

Moreover, the gradual raising of the school age and

1. Report of an Enquiry into Apprenticeship and Training. — General Report. P. 3.
2. Modern Educational Theories — Bode. P.27.

the desire to increase still further the period of full time education delays the entry of the pupils into industry and commerce, and employers feel that in older children more than a grounding in the rudiments may be looked for. Nor can this attitude be gainsaid, for with all these excursions into the years which were formerly devoted to daily work the employer must feel that although the younger worker starts later in life, his efficiency is ultimately as great or greater than before; that education has increased the interest of the worker and quickened and stimulated his mind. The calls of industry and commerce, the press and often the parents have been incessant in recent years and while the educator is at all times eager to learn and realises that education must advance hand in hand with public opinion, he must hesitate before being harried into any course of action which his better understanding of the aim of education may justly condemn. The problem of bias must be considered not only from without but from within the schools.

If the school curriculum has no bearing and is not directly influenced by the probable future vocation of the children to what degree will the 'training of the mind at school carry over'. The idea of the formal training of the faculties is not supported by experiment, indeed in recent years experiments have shown that the transfer of training is much smaller than was previously thought and for any measure of transfer there must be a similarity in the specific ideas actions and emotions and an appeal to the general mental outlook.

Again, can any subject either in the studying of it or in the teaching of it be without bias? The structure of a subject is never complete in itself. It can exist only in the mind of the teacher and student and must be biassed by their interests. The entire range of a subject with its infinite

number of different contacts can never be taught unless some selection be made. Tradition has demanded the selection of those branches which are necessary in the University and in the professions, but it has yet to be proved that these are the most suitable for the adolescent.

Is it to be assumed that after the sweeping changes of the last fifty, twenty five or even ten years conditions will suddenly become stabilised and this industry and that will continue to flourish and present methods continue? If so, then the continuance of the present rather stereotyped elementary education may be possible, or a narrow vocational training may be advocated. Or may one rather infer that the future environment of the pupil will continue to change as rapidly if not more rapidly than in the past. If this view is taken, then children must be trained for adaptability rather than a pre-determined social and vocational status, their intelligences must be stimulated, they must be trained to think not merely to repeat; by individual work and co-operative effort they must be lead to become not only good citizens but good workmen.

And with the child, must that growing interest in reality be stifled until school days are over? However the problem may be regarded from the experience of the adult, the child himself is certain. The boy of 14 will never lose the desire to walk forward and see the railway engine and if school has no use for the stir of industry and commerce the child will lose interest in the school. By legal action, the school age may be raised to 15+ or 16+ but when the compulsion is removed, and this surely is the test, the pupil of the future no less than the pupil of the past will think and think hard before he again associates himself with an

educational system in which he lost interest. It is failing in our duty if we do not use to the full the growing interest of the adolescent who stands at the threshold of a fuller life.

"The child is beginning to feel the approach of the period when he or she will go out of school into a vocation and there is grave danger if the same kind of education is continued into the adolescent school as has proved proper to the primary school that the child may come to look upon the work of the school merely as something which is keeping him back from his proper work and wait impatiently for the day when he may shake the dust of the schoolroom from off his feet".[1]

It is clear that in the best interests of the child no less than as an overture to industry and commerce, it is desirable that a broad bias or differentiation of outlook be given to the curriculum in the years of adolescence. The bias should not be too narrow for conditions are never static, it should not be limited to one industry or a particular branch of commerce for the future of the child must not be restricted his experience must be wide for his is ultimately the choice.

If then some bias is desirable the question arises as to when it should be introduced, and how long a purely general education may be extended without damage to the child, Prof. J.J. Findlay makes this clear - "The principle is evident, the younger the scholar the more general and universal should be the course of study offered to him, as he approaches the time for leaving school he can fairly demand that his curriculum be planned with some regard to his future life. And as a rider to this proposition, the longer he remains at school or College the more extensive will be the period allotted to general liberal studies; a boy who is destined to finish his

1. A Modern Philosophy of Education — G.H. Thomson.

TABLE 5. GROWTH IN PROVISION FOR PRACTICAL INSTRUCTION FOR CHILDREN OVER 11 YEARS OLD IN ELEMENTARY SCHOOLS' (ENGLAND AND WALES) 1925 - 1930.

YEAR.	NUMBER OF DEPARTMENTS WHICH MADE PROVISION FOR PRACTICAL INSTRUCTION.								TOTAL NUMBER OF DEPARTMENTS	
	DOMESTIC SUBJECTS.		HANDICRAFT.		GARDENING.		OTHER SUBJECTS.		WITH PROVISION	WITHOUT PROVISION.
	AT CENTRES	AT SCHOOL	AT CENTRES	AT SCHOOL	AT CENTRES	AT SCHOOLS.	AT CENTRES	AT SCHOOL.		
1925 - 26	3070 (5504 Departments had practical Instruction on School premises)		1789		40		41		10444	11,000
1926 - 27	3138 (5801 Departments has practical Instruction on School premises).		1845.		43		43		10879	11,000
1927 - 28	10,211	1459	7010	2737	142	5686	237	501	17829	4031
1928 - 29	10,133	1519	7103	2893	144	5653	253	611	17580	3359
1929 - 30.	9897	1595	7194	3268	146	5687	267	791	17397	3313.

GROWTH IN PROVISION ON SCHOOL PREMISES'.

YEAR	No. OF DEPARTMENTS.
1925 - 1926.	5504
1926 - 1927.	5810
1927 - 1928.	9683
1928 - 1929.	10,676
1929 - 1930.	11,431.

The Figures are taken from the Board of Education Annual Reports.

school and college life at 22 should not be troubled with specialisms at 16 or even 18; but if he is to start work at 15, he is not fairly treated if the curriculum of his school from 13 to 15 entirely ignores the type of employment in which he will enter[1]".

Intimately linked with the question of bias is the need for better facilities and the more extensive use of practical work as a medium of instruction. This practical aspect should be stressed not only in the narrower sense of the Education Acts but in all school subjects, dramatisation in literature, surveying and outdoor work in geography, actual weighing and measuring in mathematics etc. The domination of books in present day education has arisen partly due to ~~the rapid extension of the system, and~~ the ease and economy with which large numbers of children can be educated together by this means, and partly due to the fact that through the medium of books the child can become familiar with the tradition, culture and experience of civilisation. The passing on of knowledge, however, is not the only purpose of school life. The children must be educated to use accumulated knowledge not only to change their environment but also to adapt themselves to it. Mental development depends to a great extent on motor activities and though this has been increasingly recognised in the teaching of young children it has tended to fall into disuse in later school life. Experience has shown nevertheless that although some older children are able to profit by a purely 'bookish' education to the majority the only appeal is by a right balance between 'doing' and reading. This insistence on a greater measure of practical work is a feature of modern educational method and the growth of provision for handicraft and domestic science is shown by Table 5. As the former Director of Education for Warwickshire points out

1. The Foundations of Education - J. J. Findlay P.139.

"We may dispute how far the brain and hand react on one another but nobody now questions the value of teaching the boy the use of tools. It may or may not help him in his future trade; at all events it will help him in his home life and his leisure. And what is still more to the point it teaches him to think. A boy cannot make himself a bookshelf or a wheelbarrow or a wireless set or carve a tray or a picture frame without a call on his powers of design and accuracy and perhaps his sense of beauty"[1].

The Hadow report is no less certain:-

"Many more (pupils), without having any clear idea what they will do when they leave school feel ill at ease in an atmosphere of books and lessons and are eager to turn to some form of practical and constructive work" - - -

"If education is to retain its hold upon children at this critical stage of their development it must use, and not reject these natural and healthy impulses. It must be recognised that there are many minds and by no means minds of an inferior order for which the most powerful stimulus to development is some form of practical or constructive activity" - - -

"Our fourth main conclusion therefore is as follows, a humane and liberal education is not one given through books alone, but one which brings children into contact with the larger interests of mankind and the aim of the schools (selective Non selective and Senior classes) should be to provide such an education by means of a curriculum containing large opportunities for practical work and related to living interests"[2].

Industry too appreciates this side of the curriculum: The general consensus of opinion on the side of trade and industry is to the effect that more practical work should be done in schools.

1. Schools of Today - Bolton King. P69
2. Report on the Education of the Adolescent. P. 84.

It may be concluded therefore that to meet the changes in modern conditions, to retain the interest of the child and to help him through dangers of the sudden transition from school to business life, a modern type of school must, to be effective, introduce in the last two years of school life a broad bias into the curriculcum; and, while preserving the general body of the existing curriculum which experience and experiment has built up, must make some selection of subject matter to conform with the broad ideas of future vocations, professional, industrial, and commercial, which develop in the pupil at this period. Secondly, to educate for a full life, for leisure no less than for future employment, a much larger measure of practical work not only in handicraft and domestic science but in general school subjects, must find a place in the curriculum, the time devoted to this work increasing and becoming predominant for those children who have no interest and cannot profit by purely academic studies. The question arises, therefore, as to whether existing schools fulfil these conditions and if not what changes should be made in their scope and curriculum if the needs of adolescent children are to be satisfied.

CHAPTER IV

A Critical Survey of the Existing Schools.

TABLE 6. THE FUTURE VOCATIONS OF SECONDARY SCHOOL PUPILS. (ENGLAND AND WALES.) 1926.

OCCUPATION	BOYS.	GIRLS.	TOTAL.
	PERCENTAGE.		
TEACHING PROFESSION	5·7	29·0	14·2.
OTHER PROFESSIONAL COMMERCIAL AND CLERICAL OCCUPATIONS.	65·8	63·9	65·1
INDUSTRIAL AND MANUAL	22·5	5·8	16·4
AGRICULTURAL AND RURAL.	6·0	1·3	4·3.

FROM the Report of the Committee on Education and Industry. P. 76.

TABLE 7. THE FUTURE OCCUPATIONS OF SECONDARY SCHOOL PUPILS' WHO LEFT SCHOOL 1928–1929 IN THE WEST RIDING COUNTY COUNCIL AREA.

FUTURE CAREER.	1928–1929	1929–1930.
	PERCENTAGE	
Proceeded to Universities	6·0	6·4
Proceeded to Places of Special training (Sandhurst, Physical Training Colleges etc.)	2·4	3·0
Elementary School Teachers	10·8	11·9
Professional, Commercial or Clerical.	35·6	32·1
Industrial or Manual	14·5	14·3
Rural	2·2	1·8.
Domestic Occupations in the Home.	7·7	8·0
Not yet determined	9·1	9·8
Miscellaneous	8·8	8·5.

From the Annual Report of the Education Committee of the West Riding County Council

Under the present system in all County Boroughs and industrial areas some 10% of the children at 11+ , mainly from elementary schools, are educated in the secondary or grammar schools. The method of recruitment of staff no less than tradition has determined that the curriculum of these schools is academic in type and deals in general with those aspects of the curriculum which are more vital to those students who will proceed to the Universities and higher professions. Yet an examination of the future vocations of secondary school pupils shows that some 75% of the pupils pass into industry or commerce (Tables 6 & 7). Thus the bias which is introduced between 14 - 16, and which is more pronounced from 16 - 18, meets the needs of only some 25% of the pupils; and, while this type of education is in a measure also effective for the majority of children, it takes no account of the deep interests which are stirring in the pupils. The repercussions of this policy are perhaps a matter of speculation and the force of the evidence is accumulative rather than damning in particular. Each year, however, after a four or five year course, in the First School Examination, an examination which is designed to test the general education of the pupil at the end of his school career, in spite of the wide choice of both subjects and questions, in each subject 50% fail to obtain 30% of the marks and 40% fail the examination as a whole. Furthermore, many pupils 16 years of age are not even presented. (Table 8) The leakage before 16, though much has been done in recent years, is still large enough to cause misgivings and many of these children gravitate for a while into private business colleges and schools. Again, of these specially selected children, at least 20% at 15 & 16 are classed as unsatisfactory and are not reaping the

TABLE 8.

THE SCHOOL CERTIFICATE RESULTS FOR PUPILS WHO LEFT AT SIXTEEN OR OVER FOR the WEST RIDING COUNTY COUNCIL AREA. 1928 – 1930.

	1928	1929	1930.
	PERCENTAGE.		
PASSED	45·1	47·1	49·2
FAILED	12·8	12·7	13·0
NOT PRESENTED.	42·1	40·2	37·8

FROM the Report of the Education Committee of the West Riding County Council.

full benefit from the extension of their school life. How may the interests of the majority of secondary school children who eventually enter industry and commerce be stimulated and revised? There seems little doubt that in these schools no less than in other adolescent schools the principle of a broad bias towards the end of school life must find a place and as some 80% of the children leave at 16+ , the bias should be introduced when the age of the pupil is about 14.

Professor G.H. Thomson writes: 'The present type of secondary school has a bookish and abstract curriculum: it looks towards the university and the professions and it gives its pupils an education which is almost entirely useless if they do not go to a university or into a profession".

'There is a definite need for such a curriculum but it will never suit more than 10% or so of the child population, or since this is a difficult matter on which to express an opinion, let us say at any rate never more than a quarter, and this fraction whatever it is ought all to go to the University or other forms of higher education whereas today only a very small proportion do so.'

The 10% (or more) of our children taking such a curriculum ought to be more carefully selected than is the case today, everyone of them ought to have an intelligence quotient of at least 115 (if a quarter were to be chosen it would fall below that) and an interest in abstract studies; and their way through the University ought to be made possible even if they are poor"[1].

The Report on Natural Science also suggests a revision in Secondary School courses: "Lastly we are in agreement with the view that there might be a greater differentiation between the curricula of Secondary Schools in the more thickly populated areas where several schools are easily accessible.

1. A Modern Philosophy of Education - G.H. Thomson.

There is room, indeed, for a modification of curricula, so as to allow of less time being allotted in some of the schools to the study of languages other than English, and of more time being given to Science, Mathematics, Manual Instruction and Drawing (including Mechanical Drawing) in the last year or two years of the course. This would not be difficult to arrange, at any rate in those schools where a large proportion of the boys learn only one language other than English. A curriculum of this kind is more especially to be desired in schools from which boys pass into engineering and other industries of a scientific character and might well be framed with an eye to its suitability for pupils who will enter Senior Technical Schools"[1]. Mr. Hallam, Chief Education Officer has for a number of years warmly advocated alternative courses in Secondary Schools and such schools were the subject of a Report in 1927.[2]

Since the publication of the Hadow Report on no type of school has there been so much conflict of opinion as on the scope and function of the Junior Technical School. On one point and one point only has there been unanimity of opinion, that is that the schools have been a marked success.

The Malcolm Committee say: "We have heard very warm praise of the work of the Junior Technical Schools, which although they are a comparatively recent creation have for some time past won the approval of employers and educationalists alike"[3], the Hadow Report: "We consider the schools within their own province are doing valuable work"[4] and the Report on Engineering is also in agreement. "We, like all other Committees of which we have heard, have received almost uniformly favourable opinions as to the work of schools of this kind which prepare for the engineering industry".

1. Report on Natural Science in Education P. 11.
2. Secondary Schools with Alternative Courses. West Riding County Council Pamphlet 1927.
3. Report of the Committee on Education & Industry P. 36.
4. Report on the Education of the Adolescent. P. 66.
5. Education for the Engineering Industry P. 7.

That a child at 13+ shall so far determine his career as to be educated towards this end, that the idea of a 'clear cut' at 11+ shall be inoperative, appears at first sight to be in direct contradiction to the spirit of modern ideas. "The reorganisation of the educational system now in progress has drawn attention to the apparently anomalous position of this group of schools (~~J.T.S.~~ Junior Technical Schools.) Some Local Education Authorities and teachers appear to be in doubt whether these schools should any longer preserve their distinctive character; it has been suggested that their age of entry should be reduced and their curricula modified and that they should be absorbed into a universal system of post primary education"[1].

The stringent regulations for the Junior Technical School make any great extension of such schools improbable. As the report says:- "It is manifestly impossible for any large proportion of the children in modern England to know with certainty what occupations they will ultimately enter. This point was emphasised by witnesses who appeared before the Hadow committee and once it is fully appreciated it is clear that any large development of Junior Technical Schools possessing the characteristic virtues of existing schools is quite impossible"[2] - but the success of what is rather in the nature of an experiment and an experiment which strikes at the roots of modern ideas well deserves examination.

Now although we read:- "any confusion between the functions of this and other types of school will be found to lead in the long run to waste of effort and disappointment to all concerned"[3], it is not quite clear what the functions of the schools are. If the schools aim at turning out after two or three years a workman trained in technique for one specific local industry, then educationalists can have no use

1. Memorandum on The Junior Technical School. P.5.
2. P.17
3. P. 30.

for such a system; but if "by setting up a high standard of skill and accuracy the school imparts to its pupils a strong sense of individual responsibility by cultivating a pride in good craftsmanship, it lays a sure foundation for self respect for fellow workers by appealing to the deep desire of adolescence for a definite place in the world of adults, it is able to awaken intellectual interests which persist and grow long after school days are over", and furthermore as "every recognised Junior Technical School not only devotes a large part of the school week to subjects of general education, but also aims at teaching those subjects in close co-ordination with scientific and practical work"[2], then the school has a very definite and important place in the educational structure. The crux of the matter is how wide is the vocational and workshop training and how extensive is the general education. An examination of the occupations for which these schools cater shows that the schools fall into two very definite classes. In London schools are formed for "engineering building, cabinet making, silversmithing, printing, bookbinding, photo-engraving professional cookery, professional waiting, carriage & motor body building, tailoring, hairdressing, navigation and seamanship and the manufacture of boots and shoes. The courses for girls include dressmaking ladies' tailoring, millinery, upholstery, photography, hairdressing, waistcoat making and domestic occupations". In the Provinces the schools are almost entirely related to engineering and the construction Trades, courses of this type numbering 70 out of a total of 80 for boys and accounting for 10,290 pupils out of a total of 10,785. There is no possibility of any extension of the London types throughout the provinces, and the exceptional educational problems of the metropolis demand special methods

1. Memorandum on Junior Technical Schools, P.21
2. P.21
3. London Education Service P111.

TABLE 9.

NUMBER OF WORKERS EMPLOYED IN DIFFERENT INDUSTRIES 1927

INDUSTRY	NUMBER OF MALE WORKERS.
Engineering	1,033,993
Ship building	313,537
Iron and Steel	249,746
Other Metals	514,888
Chemical	189,922
Pottery	34,462
Glass	40,168
Brick and Tile.	56,607
Building	791,638
Electrical Contracting	29,560
Woodwork	174,433
Printing and Paper	241,626
Cotton	228,016
Wool and Textiles	294,500
Boot and Shoe	145640
Clothing	158,615
Leather and Leather Goods	51,124
Food Drink and Tobacco	359,782
Distributive	801,555
Mercantile Marine	175496
Miscellaneous.	2,341,047
TOTAL	8,225,153

From the General Report on Apprenticeship P. 37.

of solution. In the provinces, the only possible schools must deal with more general occupations. As the figures in Table 9 show, engineering and the constructive trades are by no means local industries, indeed, a knowledge of engineering is, in the present state of civilisation, the basis of all industries, and, provided again that a large proportion of the time is spent in general education the scope of the Junior Commercial School is equally catholic. In the provincial types of school, then the risk of 'closing' a career at 13 is not too serious. The child, with the help of the parent and the schoolmaster is in effect asked to chose a career in industry or commerce; and in this, the Junior Technical Schools go no further than what is a suggested for all adolescent education.

Criticism of the schools must go deeper. Are the Junior Technical Schools schools in the broad idealistic sense of the word, schools with a strong corporeate life with playing fields, school halls and gymnasiums, with flourishing societies and a growing tradition, schools where the outlook is still broad, where future administrators rub shoulders and form friendships with future shopkeepers and artisans; or are these schools groups of children attending a technical college? It is significant that no new buildings have been erected and when the pupils are not confined to the senior college they are educated in converted buildings.

One reads the following extract with some misgivings "To reduce the age of entry to 11 then is not necessary in the interests of the Junior Technical schools. It is in fact opposed to those interests. At the present time the whole orientation of the school is towards the adult world of industry. It is usually associated, to the extent of joint user of premises and staff with a Technical College devoted

to more advanced work in technology. If it were to admit children of 11 there would be a strong tendency for the outlook of the school to change. Furniture and equipment suitable for smaller children would have to be introduced; the teaching staff would have to adapt their tone and methods to more childish minds. These changes would react upon the atmosphere of the institution as a whole. There would be a tendency for industry to take the schools less seriously, for the older evening students to regard the building less as a place of advanced study and more as a mere elementary school. Mistaken as such feelings might be, it would not be easy to prevent their appearance; and the resulting harm to technical education in the locality might be serious. Similar harm might be done to the liberal education of adults where, as frequently happens the Technical College building provides a centre for advanced liberal education for the area".[1]

How these schools will be affected by changes in the educational structure is still a matter of conjecture. Will the transfer of pupils from Secondary and Selective Central schools prove a difficult obstacle, and, further, is it desirable for the child to change his school again at 13+ ?

"It has been found that if the parents and teachers are kept properly informed and if no artificial barriers are placed in the way of transfer the Junior Technical School has no difficulty in securing its quota of suitably gifted pupils".[2]

Yet the parent and teacher must feel that at the same time adequate facilities are offered also for the general physical and mental development of the child.

Amid the many difficulties which beset them, the remarkable success of the schools gives food for thought. In the first place it confirms the fact that there is among

1. Memorandum on the Junior Technical School. P.28.
2. P.27

more gifted children no less than among normal children a class of student who will work, and work with interest, if he can see more definitely the bearing the curriculum has on his future work. "The pupils attack their work with a seriousness and satisfaction not always found in schools for pupils of their age. They concentrate because they are interested, they are interested because they have no difficulty in realising the direct bearing of their work on their future lives. They have the air of knowing exactly what they are doing. From the purely educational point of view this is the most interesting and satisfactory feature of the work of these schools. If a cultural education means an education which cultivates to the fullest extent the latent powers of the pupil so as to fit him to take his place as a self respecting citizen in a community worthy of his membership, the unprejudiced visitor to the Junior Technical School will admit that it is giving a more cultural education than many institutions which make greater pretentions in this respect"[1].

Secondly, it seems to show that if a more definite bias is introduced, the work must be real and under the control of a teacher who has had works experience. And thirdly, that education even in early adolescence very materially benefits from a very close association of education and industry and commerce.

The Hadow report advocated the formation of selective Central Schools and these schools based, on the previously existing central schools, have developed a curriculum similar in type to that of Secondary and Grammar schools but with a definite bias in the last two years. The children are frequently selected by the same scholarship examination as for secondary schools and gravitated to central schools for a variety of reasons. Often the supply of secondary

1. Memorandum on Junior Technical Schools. P21

accommodation is insufficient and the pupils have not attained a high enough mark; sometimes it is a matter of choice, either from the point of view of gaining a more practical curriculum or because the child is not prepared to agree to stay at the secondary school until 16. When one visits schools of this type, one feels that for the general education of its pupils these are perhaps the most effective in the system. The teachers have been in a large measure recruited from the cream of elementary school staffs and the choice has depended not only on academic qualifications but tried teaching ability. The bias and the increasing use of practical work of all kinds makes it possible to retain the interest of all pupils until the end of their school career. Yet, while the work of these schools is similar in scope and at least equally as efficient in operation as the work in Secondary schools, the Central Schools are still definitely under Elementary School regulations. It is due to this fact, and this fact only, that these schools may act as a drag on the future development of post primary education.

The Hadow report deprecates any measures which might reflect on the increasing facilities for secondary education: "The 'secondary' school in the sense in which the word secondary is most commonly used today falls outside our terms of reference and there is only one point on which it is necessary to touch in connection with it. That point is, however, important. It is the necessity of ensuring in the development of other forms of post primary education that nothing is done to cripple the development of secondary schools of the existing type"[1].

While the evidence before the Hadow Committee on the interaction of Secondary and Central Schools was somewhat

1. Report on the Education of the Adolescent. P.80.

conflicting the evidence in many cases in not equally uncertain.

'In one large city at any rate a number of central schools have been opened without any disguise to provide an education which is almost identical in curriculum with that of the Secondary School. The reasons assigned are frankly to avoid the heavy expense of procuring land, buildings and staff needed is satisfy the Secondary School regulations of the Board of Education. A few elementary school buildings are set aside for this purpose, the teachers are paid pretty much on the elementary school scale, and a form of instruction is offered similar to that in the neighbouring Municipal secondary school. One can only hope that the rivalry between Central and Municipal Secondary schools will not approach the vehemence of the competition witnessed up to 1903 between higher grade and endowed grammar schools.[2]

In Sheffield an increasing number of central school children are successfully attempting the School Certificate Examination with the inevitable comparisons of the expenses of central and secondary schools. In explaining the different purposes of these schools the difference in length of school life is often stressed, the difference in school life was in 1925 6 months for boys and 3 months for girls in the favour of secondary schools.[3] At present the average age in secondary schools is 16 years 6 months for boys with an average school life of 4 years 8 months and these figures it should be remembered are increased by the 10% or so of pupils who stay on until 18 or 19. The tendency of Central schools is also to encourage the pupils to stay at school for a fifth year. "In such schools (selective Central schools) the number remaining for the fifth year may be small but there are instances in which the percentage taking the fifth year course is fairly high and constantly growing"[4].

1. Compare Education of the Adolescent P.81 - P.126
2. The Foundations of Education - J.J. Findlay P. 134
3. The Next Step in National Education. P 104.
4. The Educational Year Book. 1932.
   Lord Eustace Percy. P. 150

The position of the selective central schools is reviewed by Mr. Bolton King. "The Board insist that the Central school is not to be taken as an inferior substitute for the Secondary School. This, of course, is fundamental and so far as teaching and tone are concerned is already the fact. A careful comparison of Secondary and Central Schools in one district demonstrates that the teaching in the latter is not inferior, is in some respects even better and this conclusion is confirmed by evidence from other quarters. The elementary headmasters who control the Central Schools are for the most part more living and up-to-date, they have more initiative, they do not surrender to tradition and conventions. Above all the schools are free from the incubus of examinations which darken their secondary compeers. But while the Board enhance the dignity of the Central School, they find it convenient to forget how sorely it is depressed by the inferior status to which they have regulated it. In their eyes it is still officially an elementary school. Its working, costs at most £18 - £20 per pupil as against nearly £27 at a secondary school. In place of the sumptious buildings which the latter enjoys, the Board allow the Central school little more than what every elementary school possesses. Each child has a floor space of 12 square feet as against the minimum of 16 feet at the secondary, the central school has little or none of the latter's lavish supply of laboratories, art rooms, music rooms, it often does not possess that essential of organised school life - a hall large enough to assemble all the children; as often as not it has no playing fields. The classes, at all events in the bigger schools are much above the secondary limit. No child may remain after 15 except with the Board's consent. The teachers are paid on the Elementary scale and a niggardly

regulation permits not more than half to have the extra allowances contemplated by the Burnham Committee" - - - "The whole Central system bears the official stamp of inferiority and we have to thank the enthusiasm of the teachers and not their masters if the schools are as good as they are,".

It seems, therefore, that as these types of school for selected children, secondary schools, Junior Technical Schools and Selective Central Schools are developing, the ultimate aims appear to be converging. If the secondary and grammar schools are to extend and become more effective, more attention must be directed to the majority of children who leave to enter industry & commerce; some bias must be introduced and more practical work is necessary. The Junior Technical School, while satisfying a definite need, is gravely concerned with difficulties of securing suitable recruits at 13+ ; and must, in the best interests of adolescent education, develop a more characteristic corporate life. The selective central school while developing a course of study until 16 is seriously hampered by being still under elementary school regulations.

The epoch making result of the work of the Hadow Committee, however, was that it in part recalled educationalists from the interesting and absorbing experiments on the abnormal children, both supernormal, and subnormal, and redirected attention to the education of the larger mass of normal children. Before the publication of this report, one feels that the proper education of these children between 11+ and the legal leaving age had been somewhat neglected. Now as reorganisation is being effected these children are being grouped in Senior and Non selective Central Schools and the best type of curriculum for these children is as yet in the experimental stage. So much so that one feels that the best interests are served

1. Schools of Today - Bolton King. P.30.

rather by suggesting lines on which these schools may develop than attempting to criticise particular schools.

However successful these schools may be the majority of the children will leave school when they reach the legal leaving age that is at present 14+ .

Attempts to carry out the Recommendation of Hadow Report and raise the school leaving age from 14+ to 15+ have failed.

"Our last report (1930) dealt with the preliminary steps taken to prepare for the raising of the school leaving age to 15 as from April 1931 and referred to the Bill introduced for this purpose in December 1929 while the following chapter of this Report gives some account of the two Bills subsequently introduced in May and October of 1930 respectively. The former of these which received a second reading but could not be carried further before the end of the session, provided not only for the raising of the leaving age, but also for enabling local education authorities to make agreements in certain circumstances with Managers of non-provided elementary schools for contributing to the cost of enlarging or reconditioning their premises for the purposes of reorganisation. The latter was still under consideration in the House of Commons at the end of the year and was rejected by the House of Lords in February 1931. Amendments had been made in the Commons, postponing the date for raising the leaving age to Sept. 1932 and providing that the Bill should not come into operation till an Act should be passed authorizing expenditure out of Public funds to enable the managers of non-provided schools to meet the requirements of the Bill[1]". Thus until further developments in this direction are possible, the education of normal children between 14 and 16 must be either by Evening Classes or Day Continuation Schools. That over 50% of children

1. Education in 1930.
Report of the Board of Education . P.1.

between 14 and 16 are lost sight of, is one of the most discouraging aspects of the social organisation of England and Wales. These children, in this most difficult period of adolescence, are, whether employed or unemployed, allowed to 'roam wild' until at 16 they are again brought to notice under the National Insurance Scheme. Much has been done by voluntary organisations, by religious bodies, by scout movements, by welfare associations and by Juvenile Employment Bureaus; but much is still to be done and educational bodies must take the lead.

"Children leave school just as the golden period of education is beginning and the laborious training which is given up to 13 - 14 functions imperfectly unless school goes on beyond. It is a huge national waste to carry education just to the point when it begins to make itself felt and not to gather in the harvest which the succeeding years would bring. Sir Geo. Newman has emphasised the loss to health through the escape from school medical supervision at 14. The moral loss is more serious and increases as skilled craftsmanship declines in the new industrial evolution and with it the moral stimulus which came with an effort to master it. Children are withdrawn from influence and control just when they most need it and the most critical years of their life pass in a dangerous liberty[1]".

The figures for attendance at part time evening classes (Tables 3 & 4) are low but even these figures do not show the whole truth. The figures represent the number of pupils on the registers at the beginning of the session, and the leakage in evening schools is high.

Nor is this state of affairs surprising; with the introduction of group courses the pupils are expected to attend on three evenings a week, generally from 7 p.m. to 9,

1. Schools of Today — Bolton King. P.10.

or 9,30 p.m. and in addition to do a certain amount of homework in each subject - and this after working from 7.30 to 5 p.m. The period 14 - 16 is difficult and only the more robust of the children can carry out the course to a successful conclusion. The results of such an effort are, to many children, not very tangible; and attendance, except for physical exercise, often seems hardly worth while. Undoubtedly The lines of advance must be by extending the facilities for day classes.

Of the various Day Continuation Schools which were started after the 1918 Act, only the Rugby Schools remain and it is instructive to enquire into the causes of failure of the various other schools.

The collapse of the schools may be discussed under two heads the external influences and the internal or educational influences.

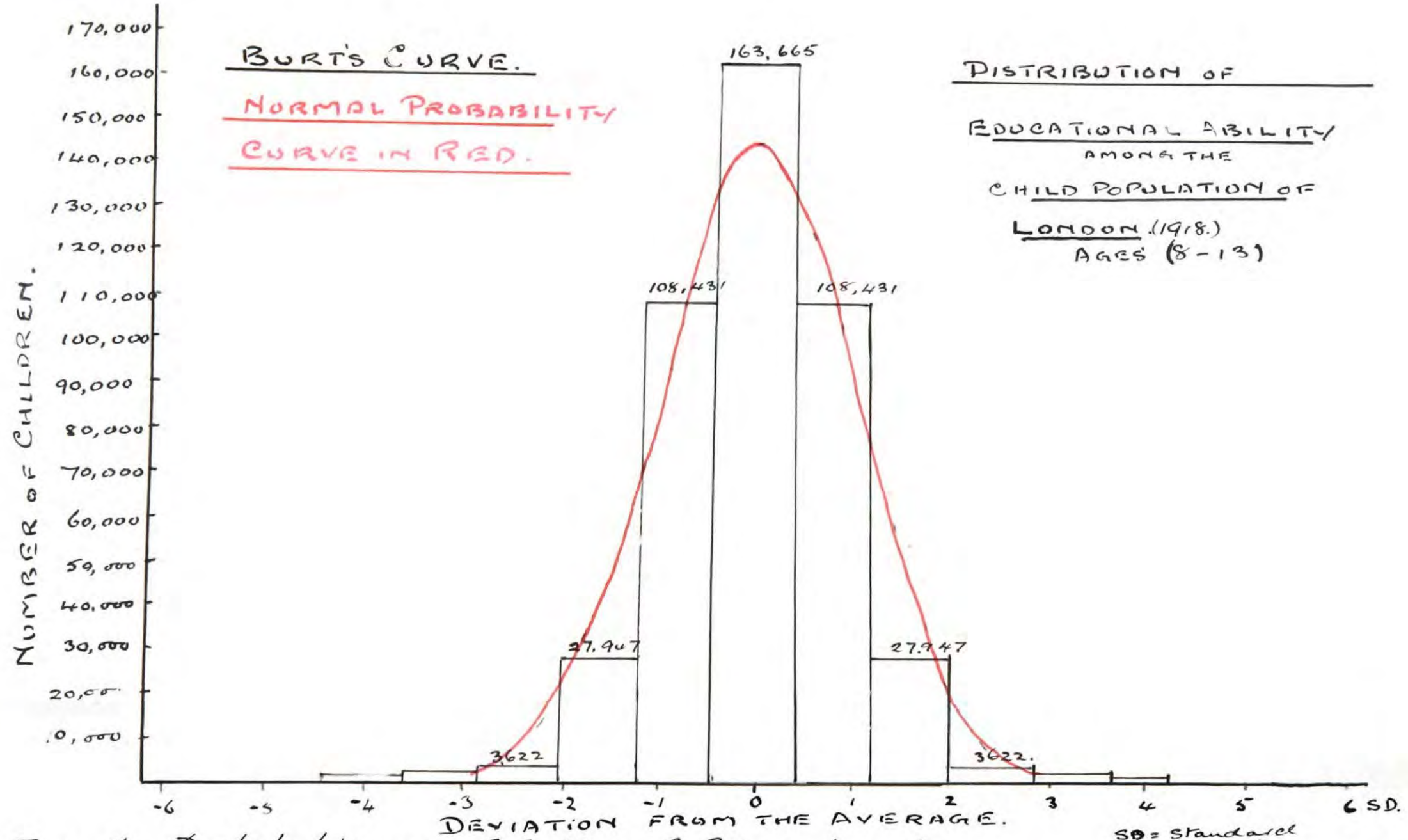
The establishment of the schools was not universal, and the development of the schools which were formed, coincided with a period of growing unemployment, the pupils therefore feared that they were handicapped by having to attend. Economy was rampant, the notorious Geddes Axe was being wielded unmercifully and the schools were attacked by a section of the press on the grounds of extravagance. Some employers, too, failed to realise the value of the schools and forced the children to attend on half holidays, protest by the child or authority leading to the dismissal of the child. But equally important ~~were~~ was the failure from educational reasons. The buildings were inadequate and not properly adapted for educational purposes. Clubrooms, Sunday Schools etc. were used and no facilities were offered for practical work of any description. The pupils formed heterogeneous groups of widely different ability and the teachers ~~unacquainted~~ unacquainted with either their past or future were entirely out of touch with the pupils.

Development of Day Continuation Schools is necessary, and if any real progress is to be made these educational factors must be given serious consideration. Success will not be achieved until the country has experimented widely with a scheme of voluntary day continuation schools which will give an opportunity for creating an efficient teaching staff for evolving a suitable curriculum, and for erecting buildings. Above all such a scheme must gradually accustom the public mind to the idea of part time continued education, and demonstrate its advantages both to the pupils and to those who employ them, The whole history of educational development in this country suggests that this is the proper line of advance*.

CHAPTER V

The Principles of Grouping of Adolescent Childr n.

DIAGRAM II



From the Distribution and Relations of Educational Abilities. P. 42.

Before forming definite conclusions as to the structure of the educational system in Country Boroughs and Industrial districts, the principles underlying the grouping of different types of children must be studied in more detail.

"The education of the individual is no doubt the ultimate purpose of any national system but no state can afford to train its citizens on the plan of private tuition. This would mean a life for a life; each generation would have to sacrifice most of its activity to the preparation of the next".

As children must be educated in groups, it is vital that the groups should be as homogeneous as possible. The selection of the children is based on the principle of their being 'capable of profiting' by a type of education which experience and experiment has built up to suit children of a recognised kind.

Capable of profiting involves two conceptions, first general intelligence, and secondly specific qualities such as the character, interests, disposition etc. of the pupil. In rearranging children at 11+ educationalists are concerned more with capacity than attainments and although these cannot be entirely separated, tests at this age are primarily to grade the children on their intelligence. "Most psychologists would probably agree that intelligence is a general mental ability operating in many different ways, given as part of the child's natural endowment as distinct from knowledge or skill acquired through teaching or experience and more concerned with analysing and co-ordinating the data of experience than with more passive reception of them"[2]. If intelligence is innate then like height, build and other hereditary characteristics, the distribution of intelligence among the population should follow the laws of probability.

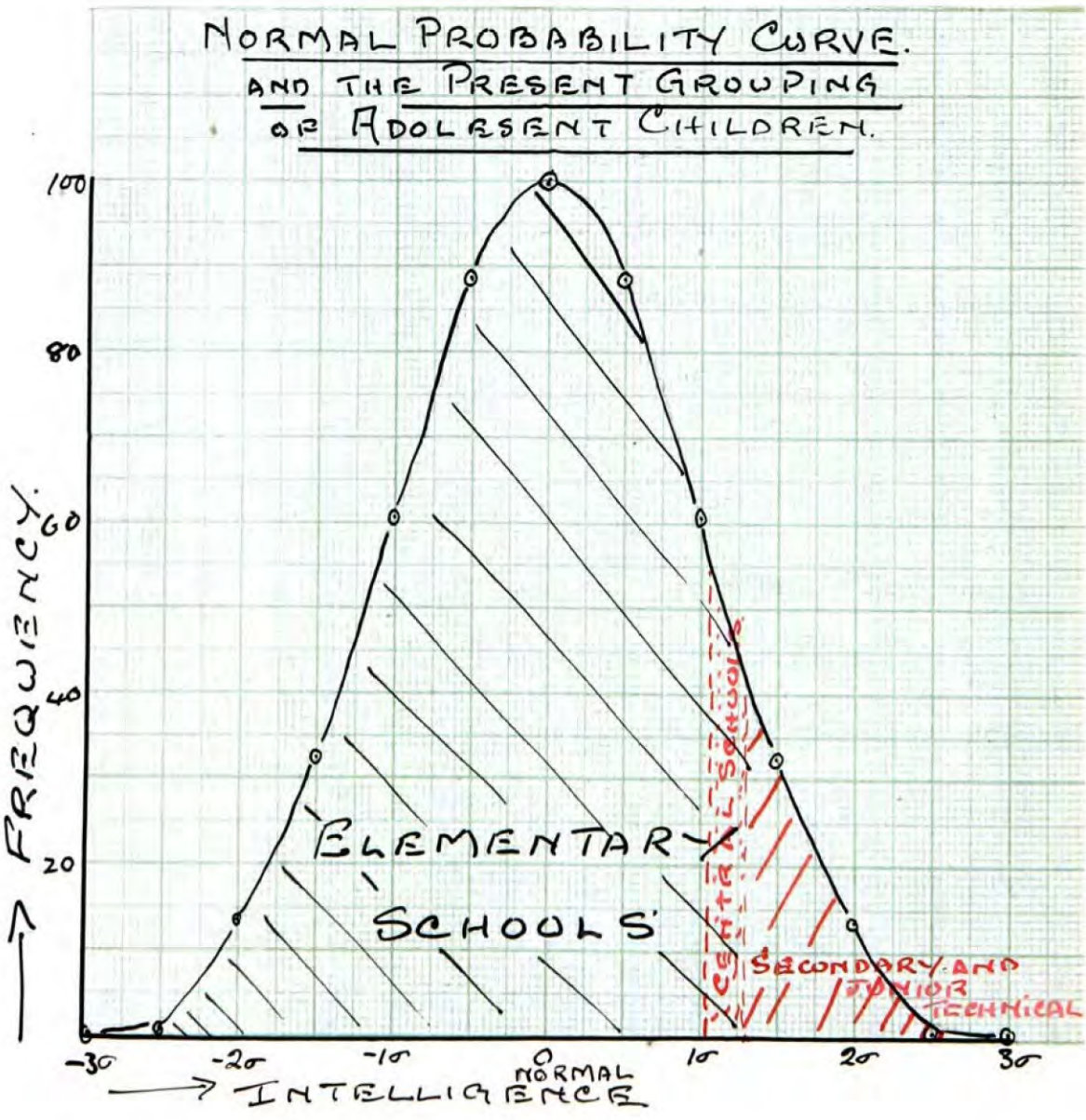
1. Modern Developments in Educational Practice -
2. Psychological Tests for Educable Capacity. — P. 7. Sir. J. Adams.

TABLE 10. A TABLE FOR THE CONSTRUCTION OF A NORMAL PROBABILITY CURVE.

DISTANCES FROM THE MEAN IN TERMS OF σ (THE STANDARD DEVIATION)	VALUE OF ORDINATE y. $y_0 = 100$	PERCENTAGE OF TOTAL AREA BETWEEN MEAN AND ORDINATE.
0	100	0
$.5\sigma$	88.2	19.15
1.0σ	60.6	34.13
1.5σ	32.5	43.3
2.0σ	13.5	47.7
2.5σ	.44	49.4
3.0σ	.11.	50 (approx.

From Statistical Methods applied to Education — Rugg P. 205.-388.

NORMAL PROBABILITY CURVE. AND THE PRESENT GROUPING OF ADOLESCENT CHILDREN.



NOTE. The Equation of the Curve is

$$y = \frac{N}{\sigma\sqrt{2\pi}} \cdot \varepsilon^{-x^2/2\sigma^2}$$

and the Total Area between any two ordinates

$$\underline{a} \text{ & } \underline{b} = \int_a^b \frac{N}{\sigma\sqrt{2\pi}} \cdot \varepsilon^{-\frac{x^2}{2\sigma^2}} dx.$$

where N = number of Cases

σ = Standard deviation $= \sqrt{\frac{\Sigma f d^2}{N}}$

f being the frequency and d the deviation from the mean

In an extensive survey of the distribution of educational abilities among London children Mr. Burt found that this was approximately correct (Diagram II.)

"Apart from these disturbances attributable chiefly, it would seem, to observational error, the results are consistent with the hypothesis that like physical stature and many other anthropological features, but unlike wealth or land, educational ability is normally or nearly normally distributed among the population"[1]. Furthermore the distribution among age groups follows the same Law[2]. As a tentative theory therefore it may be assumed that over a fairly wide area; e.g. a County Borough, the distribution of general intelligence of children at 11+ will approximate closely to the ideal curve. Furthermore the general intelligence of such a random selection of children at 11+ is not like a fruit crop, unless some calamitous and far reaching factor like the Great War fundamentally disturbs existing conditions the curve should from year to year be fairly consistent. Thus, from the point of view of general intelligence, the grouping of children should in a general way conform to the normal probability curve. The curve on the opposite page shows the normal distribution of intelligence and the percentage of children in different schools for the whole country, is proportional to the areas marked (See Table 8)

It is seen that while some uniformity of intelligence has been attained in Secondary, Junior Technical and Central Schools in Elementary schools, where large classes and inferior accommodation make effective education more difficult, there is a wide divergence of ability.

If the grouping of children is regarded from the point of view of intelligence quotients (I.Q), the same conclusion

1. The Distribution and Relations of Educational Abilities — Burt. P. 34
2. P. 23.

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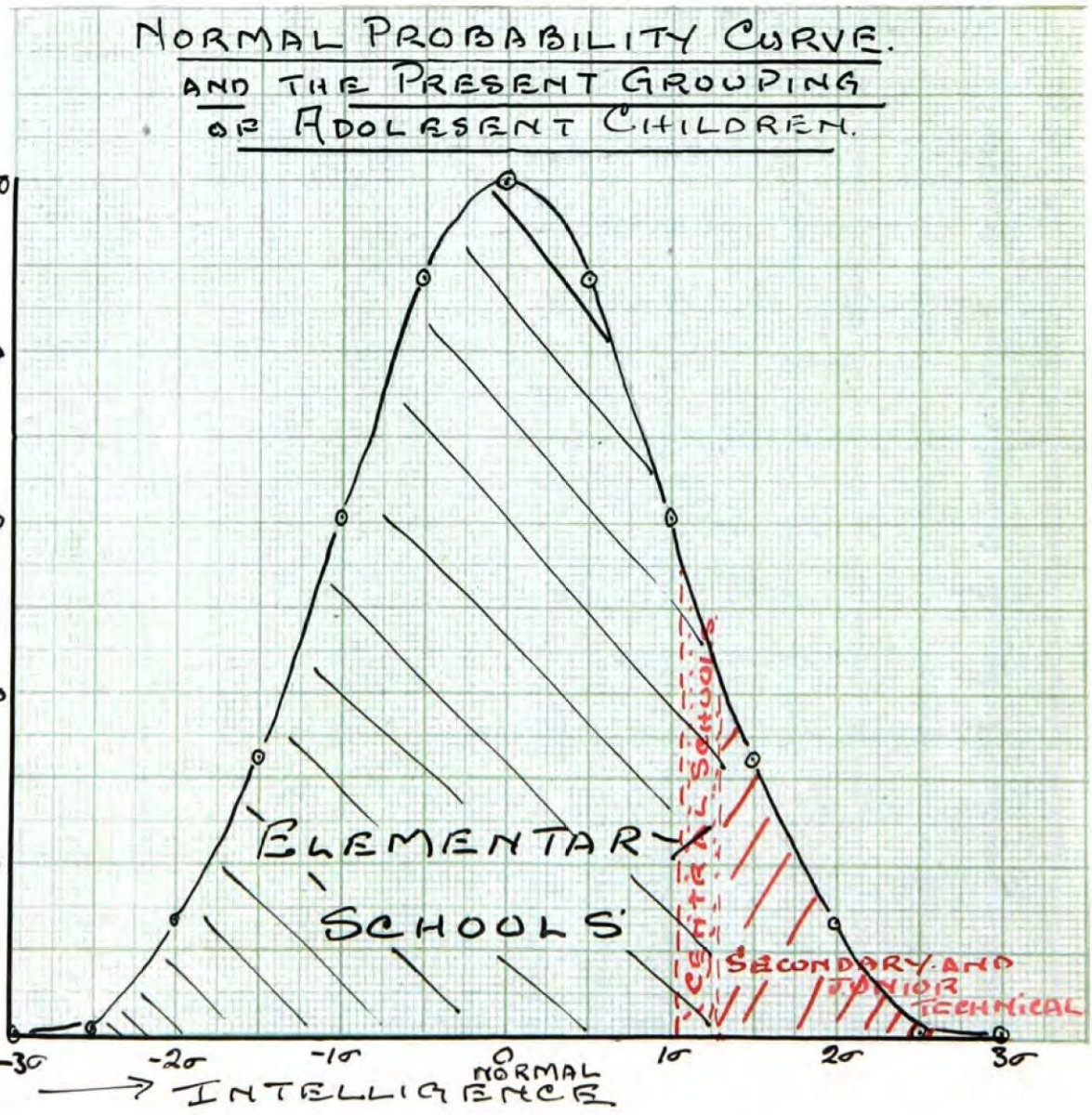

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1. The Distribution and Relations of Educational Abilities — Burt. P. 34
2. P. 23.

TABLE II. THE DISTRIBUTION OF INTELLIGENCE QUOTIENTS IN RANDOM SAMPLES OF THE POPULATION.

INTELLIGENCE QUOTIENTS. I.O.	OCCURRENCE.	COMMENT.
A. CHILDREN.		
200	Very rare	Genius
150	.02%	Secondary School and University
130 – 150	2 – 3%	Secondary School
115 – 130	10%	Central School
100 – 115	38%	Good average Elementary
85 – 100	38%	Poor average Elementary
70 – 85	10%	Dull and Backward
50 – 70	1.5%	Feeble minded
Below 50	.5%	Idiot & imbecile.
B. ADULTS.		
150 +	.1	Higher Professions
130 – 150	3%	Executive and Junior Professions
115 – 130	12%	Clerical & Highly Skilled Technical
100 – 115	27%	Ordinary Skilled Technical and minor Commercial.
85 – 100	36%	Semi-skilled & mechanical
70 – 85	18%	Unskilled Labour
50 – 70	4%	Casual Labour
Below 50	.2%	Imbecile.

From The Learning Process – Bloor.

is arrived at. Table 10 shows the distribution of I.Q. in random samples. It is clear that while for supernormal children, to meet the greater variation in intelligence smaller groups have been formed; subnormal children, where the variability is equally great, either from conviction or lack of appreciation are still classed with the normal children.

If children are to be classed at 11+ by their educable capacity then it is difficult to avoid the conclusion that some test of capacity must be made at this age. As the Departmental Committee found "No evidence we have heard has shaken our conviction that under existing conditions the advantages of a well conducted examination out-balance its occasional mistakes[1].

If such a test is determined upon, every child should have its opportunity and this again was the opinion of the Committee.

"After considering the arguments for and against we have come to the conclusion that all boys and girls in elementary schools who have reached the age of 11 should be examined for scholarship purposes with the exception of those who at the age of 11 have failed to reach a place in the school corresponding to that reached by their contemporaries"[2].

Nor should even these children be excepted if the underlying principle is a suitable grouping of children rather than the award of scholarships.

As the Minority Report pointed out a general examination is not without danger. It may lead to a distaste for learning, a restriction of curriculum, and over-pressure; but these dangers can be largely mitigated by the framing of the test. The test should become part of the school routine, conducted in school and in school hours and follow closely

1. Report of the Departmental Committee on Scholarships & Free places (1920) P. 63.
2. P 75.

the suggestions of the teachers. As the examination is framed to test capacity rather than attainment, it is clear that it is not necessary or advisable to test the whole range of the school curriculum, but to confine the test to these subjects which are correlated most closely to general intelligence at this age.

"The written examination should be confined to English and Arithmetic" - "The reasons for limiting the written test to English and Arithmetic are clear." "We have been told by a psychologist who has made a special study of the problem that at the age of 11 to 12 these are the subjects that correlate most closely with general capacity. Common sense suggests that the limitation of the test to these two subjects minimises the risk of special preparation and prevents the examination from dominating the syllabus and methods of the primary school[1]".

Many authorities, of which Leicester is a good example, have by organisation and a wise policy in framing the questions in these subjects greatly minimised the disadvantages of a general examination at 11+ but some authorities have much to learn as to the correct treatment of the results of the test. The organisation and marking of the School Certificate Examinations and the modern methods used in psychology might be studied with advantage. The test at 11 has an important bearing on the future of the child and any expenditure on expert advice is well spent and is more economical than drafting the child into an unsuitable type of education.

'If questions in written examinations for younger children were always set with due regard to the peculiarities of the child mind, both in the form and matter of the questions and in their arrangement in the written papers and if the same scientific methods were employed as in 'intelligence' tests

1. Report of the Departmental Committee on Scholarships & Free Places. P 64.

and standardised scholastic tests, such examinations would prove a more effective means of discovering ability in young children than those now in use even apart from the application of group tests of intelligence[1].

Educable capacity or ability to profit by different types of schools, however, means more than a grading by intelligence and the more information that is available the more likely is the grouping of the children to be correct. An oral interview is necessary and a full history of the child must be available. As the Committee found. "Our witnesses were practically unanimous in thinking that an oral examination should form part of the selection test. It should be subsidiary to the written examination its main purpose being to serve as a corrective."[2] The need for establishing a system of Personal and School records in all types of schools cannot be too strongly emphasised. As specialisation is increasing the teacher is more and more restricted in his full knowledge of the child and what is needed not only in grouping tests at 11+ but for school leaving certificates etc. is a complete history of the child not the subjective estimation by one or two persons.

"We cannot understand the individual pupil unless we know something of its health, temperament, home, parents inclinations and general attitude and bearing. It is unfair to the pupil and to the teacher to expect the latter to give an educational prescription based on a diagnosis which is made perforce on insufficient knowledge"[3].

Light is necessary not only on the scholastic attainments but on the physical, mental and social life of the child. In America much has been done. In England the work of the National Institute of Industrial Psychology which suggests

1. Psychological Tests for Educable Capacity. P.14.
2. Departmental Committee on Free Places P 65.
3. The New Senior School — Gunton . P. 95

eight lines of enquiry - home and family circumstances, physique and general health, intelligence, manual skill, mechanical abilities, occupational interests, temperament and character - must receive more general recognition.

Yet even when these precautions are taken, it must be realised that the grading is tentative and not irrevocable,. "Any system of selection whatever whether by means of psychological tests or by means of examinations which determines at the age of 11 the educational future of the child is, and must be, gravely unreliable."[1] In any system from 11+ to 13+ more particularly, adequate provision must be made for the easy transfer of pupils from one type of school to another.

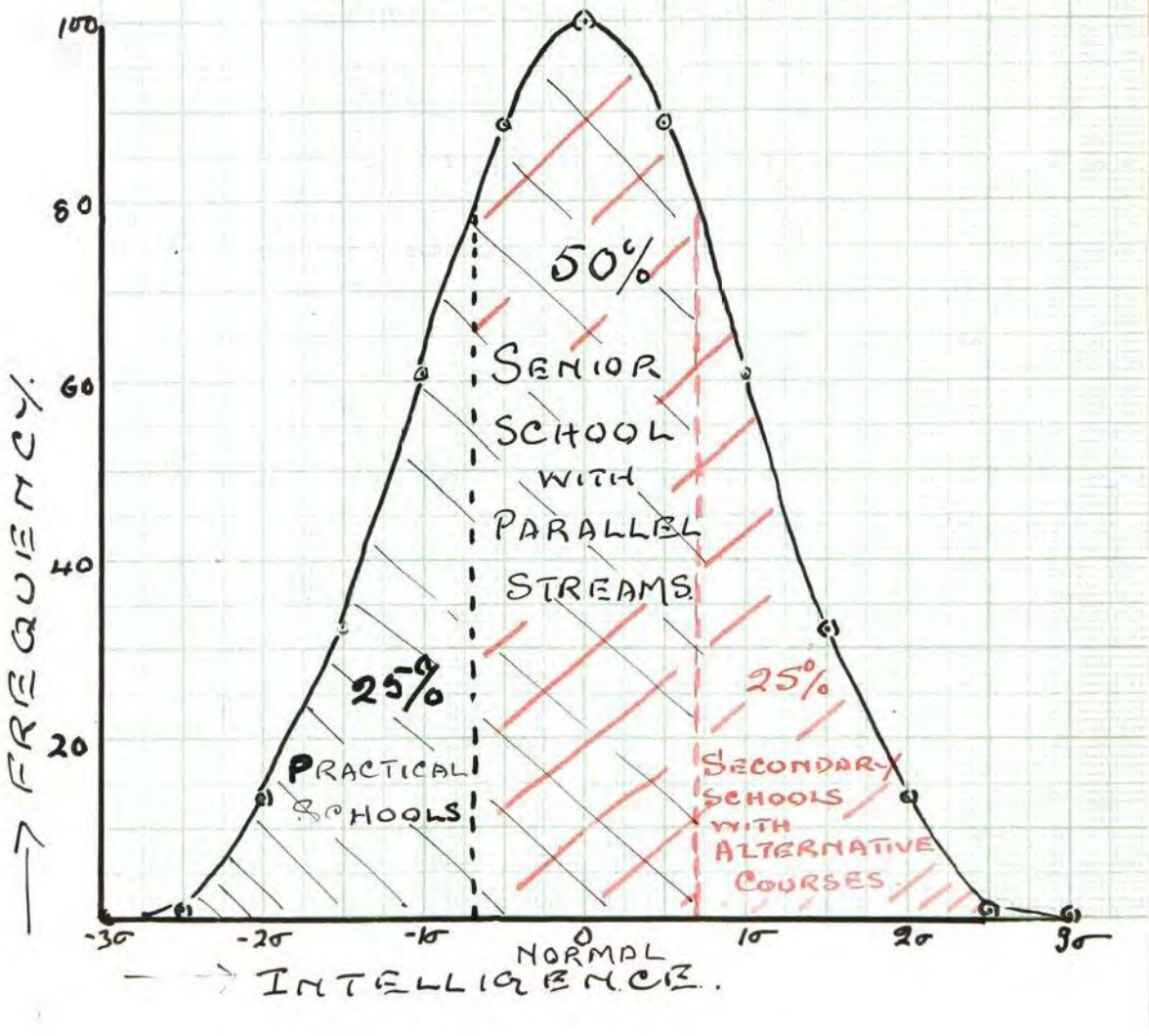
"There is abundant evidence to shew that some boys and girls develop late and may at the age of 12 or 13 display distinct aptitude for the type of education given in existing secondary schools. We think that, where it is possible to do so, arrangements should be made for the transfer of such pupils to secondary schools. Witnesses - - - urged that adequate arrangements should be made for the transfer of - - pupils from Secondary Schools to either Central or Junior Technical Schools. We wholly agree with this view"[2].

1. Psychological Tests for Educable Capacity P. 108
2. ~~P. 193~~. The Education of the Adolescent P. 193.

CHAPTER VI.

Reorganisation in County Boroughs and Industrial Districts.

SUGGESTED GROUPING OF ADOLESCENT CHILDREN.



"England," says Lord Eustace Percy, "is obviously engaged at the present time in an effort, more deliberate than is usual with British policies, to effect what may be called an integration of her whole educational system!". To further this integration, rather than to suggest any standardisation of the system, it is desirable to summarise some definite conclusions as to future structure and progressive development of the education of the adolescent in the more densely populated areas.

I. At the age of 11+ there should be a general test for all children, and, as adolescence is a physical rather than a mental change, qualification should be based on age rather than ability. If it is thought desirable, however, children of 12+ who through illness or other causes were unable to take the test at 11+ might be included with suitable adjustments for differences in age. This examination should be part of the school curriculum, that is conducted during school time in the schools where the children are in attendance. Adequate arrangements of Central and District Boards etc. should be made to ensure that the test is suitable for the children and the examination might even be 'tested' in another area. The test should be in English and Arithmetic though a subsidiary intelligence test might be set. The marks of the test should be carefully standardised and on the results of the test with due regard to an oral interview and the child's record card the children should be arranged in three main groups'.

(a) A <u>Secondary School group</u>. This group should ultimately consist of about 25% of the more intellectually able children. As the Board of Education states: "it is general experience that difficulties follow if much more than some 25 per cent of the children are selected at the age of 11 for admission to secondary and Central schools together. On the one hand, it will probably be found that some children

1. Educational Year Book. 1932. P. 25.

selected are not of a sufficiently high standard and their presence will then act as a drag upon the work of the whole Central School. On the other hand, if so many of the brighter children are selected, the ordinary Senior schools are left with a very high proportion of their children belonging to definitely duller types." [1] Approximately the same figure 20 per 1000 population was suggested by the Departmental Commission on Free Places.

At present the schools for this group of children are Secondary and Grammar Schools, Junior Technical School, and Selective Central Schools. In some districts due to the tradition and success of Central and Junior Technical Schools, these schools will be retained, but it should be a definite policy of the Board of Education that these schools shall conform in a general way, for staffing, accommodation, playing fields apparatus etc. with the Regulations for Secondary Schools and, furthermore, these schools should be given definite Secondary School status as for example Secondary Schools, Type A.[2] In areas where Junior Technical Schools and Selective Central Schools are not of old standing, the policy should be to extend the existing facilities for Secondary Schools. As was indicated, when the Secondary School provision rises above about 10% of the number of children there is a pressing need for the introduction of some bias, suitable not only to the children who proceed to higher education but also for the majority of children who pass into industry and commerce. Thus the scheme of the Secondary School should be altered so that in the last two years of the child's school life provision is made for a definite bias. In general, three divisions will be formed; academic, commercial, and industrial, though all three divisions will not be necessary in all secondary schools. In developing the bias attention should be directed to the

1. The New Prospect in Education. P. 23.
2. Compare the Organised Science Schools 1906.

factors which have contributed to the success of the Junior Technical Schools. The work done in each division must have that reality which is attained by a proportion of the staff having works experience, a stressing of practical work and a very close relationship, on the one hand with the facilities for higher education and on the other hand with the employers and workers in industry and commerce.

The advantages of a secondary school with sides or alternative courses may be briefly summarised as follows :-

(i) It is always difficult to create different types of schools doing similar work without the question of social inequality arising, especially if one type is under regulations for elementary schools.

(ii) The education in a Secondary school with sides tends to be less narrow than when the children are segregated according to future occupations as in the Junior Technical Schools. The children doing different types of work develop a broader outlook by mixing in the games and corporate life of the school. The value of this is recognised by the growth of Universities. Furthermore a better appreciation of the value and importance of practical work is encouraged - handicraft is no longer regarded as in any way degrading and the criticism of education for 'black coated professions' does not hold

(iii) The difficulty of the extensive recruitment of suitable pupils at 13+ does not arise as it does in Junior Technical Schools. During the years 11+ to 13+ the staff of a secondary school with sides have ample opportunities of watching carefully the progress of all the pupils and at 13+ or 14+ are the better able to advise them on the most suitable course. The practical difficulties of transfer between different schools

are too wellknown to need recapitulation, whereas the existence of different courses in the same school renders much easier the regrouping of those children who may reveal different aptitudes as development proceeds.

(iv) The terms Secondary and Grammar have lost their precise meaning and when used in connection with education have come to represent an education of a very definite standing. The demands by industry and commerce for secondary school pupils have grown more pronounced in recent years and if the social standing of the secondary school is associated with the practical advantages of the Junior Technical School a better understanding between Education and Industry and Commerce will result.

There are almost inevitably dangers against which to guard in this type of school. The academic side of the curriculum must not again become dominant and the best interests of the commercial and industrial sides must not be subordinated to a rigid system of examinations. Again while with older children a larger school is possible and advantageous the school must not be so large as to be unwieldy there must be a very close co-operation between the various sides. These difficulties are not confined to a Secondary School with Sides and may be largely eliminated by an appreciation of the objects of the school and a wise choice of staff.

A Senior School group.

This group, the normal group, should contain about 50% of the children. Again some districts may continue this type of school under the head of Non selective Central School though Senior School seems preferable. The children in this school will be divided into 'parallel streams' of different ability, either two streams or for bigger schools three streams.

Though the introduction of bias will be a feature of these schools, the general type of curriculum is still unstable and progress towards a most suitable curriculum must be a matter of experiment. As public opinion becomes more enlightened the accommodation etc. of these schools should develop on the same lines as that of Secondary Schools.

Closely connected with the development of the Senior school must be an extensive development of facilities for children who leave at 14+ to continue their general education to 16. While Evening Classes for these pupils may be continued it must be realised that education of this type can never be efficient for young persons. Experiments should be directed towards establishing a system of Day Continuation Schools. For some time these schools will be run on a voluntary basis, but, as public opinion becomes more favourable, compulsory measures will be introduced. "The History of English Education shows us that compulsion to attend school has followed closely upon the general development of educational facilities"[1]. Immediate measures might be taken to ensure the attendance of children between 14 - 16 who are unemployed.

In the development of Day Continuation Schools the previous causes of failure should be carefully studied. Suitable buildings, provision for practical work, and qualified teachers are necessary. Provision of Day Continuation Schools is in the nature of a temporary measure, for it is always possible that the school leaving age may be raised. The expense of building new schools and the staffing of these schools gives cause for serious thought yet provision for the 50% of children between 14 and 16 who do not attend any further education is a vital necessity.

It is suggested that children on leaving school at 14+

1. The Next Step in National Education.

TABLE 12. THE NUMBER OF CHILDREN IN THE 11-12 AGE GROUP FOR DIFFERENT YEARS 1926-1936.

YEAR.	ESTIMATED NUMBER OF CHILDREN in 11-12 AGE GROUP.	
1926	696,900	
1927	653,570	
1928	607,360	
1929	540,330	
1930	530,410	
1931	742,110	('BULGE' YEARS.
1932	769,560	
1933	732,020	
1934	685,790	
1935	659,700	
1936.	645,750	

From The Board of Education Annual Report 1929-1930 P. 108.

TABLE 13. TIME ALLOTMENT FOR DIFFERENT SUBJECTS IN DAY CONTINUATION SCHOOLS IN RUGBY.

SUBJECTS.	NUMBER OF HOURS A WEEK.		
	INDUSTRIAL BIAS.	CLERICAL BIAS.	DISTRIBUTIVE TRADES.
A. Boys'.			
English Subjects	½ hrs	1 hr	½ hrs
Handicrafts	½ hrs	½ hrs	½ hrs
Experimental Science	1 hr	1 hr	—
Physical Training	1 hr.	½ hr	1 hr
Mathematics & Drawing	1 hr.	—	—
Commercial Arithmetic	—	1 hr.	1 hr
Shorthand	—	1 hr.	—
Book Keeping.	—	—	1 hr.
B. GIRLS'.	CLERICAL		HOUSECRAFT.
English Subjects	2 hrs		½ hr
Needlework	1 hr		1 hr
Physical Training	1 hr		1 hr
Domestic Science	—		½ hr
Commercial Arithmetic	1 hr		—
Shorthand	1 hr		—
Art.	—		1 hr.

should be, for the purposes of continued education associated with their own schools. This involves arranging provision in the Senior schools for some 40 - 80 children on different half days during the week, and it is clear that this suggestion involves considerable interaction between the two schools. The internal arrangements of the Senior school which makes this possible will be dealt with when the general curriculum of the Senior School is considered.

The advantages of such an arrangement are,

(i) No separate new buildings are required and any extension of the Senior School premises will be also available for the Senior School itself. Furthermore in areas where provision has been or is being made for the 'bulge years', (due to the increase in the birth rate after the war [Table I2], the fall in the school population in the succeeding years will remove any necessity for further extensions. If on the other hand the school leaving age is raised the extra accommodation is already at hand.

(ii) The difficulty of recruiting a complete staff of suitably qualified teachers no longer arises. One or two extra teachers must be appointed and an increase in the staff will facilitate the efficient organisation of the Senior School.

(iii) The staff will have a thorough knowledge of the abilities of the Continuation School pupils and there will be no discontinuity in the education of the children. As the authorities of Rugby have found, any special vocational training at this stage is not necessary nor desirable. The time allotment to different subjects in the Continuation School at Rugby is shown in Table 12.

(iv) Provision for practical work is available and any farther supplies of apparatus will benefit both schools.

(v) The close relations of the two schools will do much to fill in the gap between school life and future work and will further the ultimate aim of full time education for all children up to 16.

C. A Practical School group.

This group should contain the less intellectually able children and be about 25% of the whole. The establishment of separate schools for these children is recommended not only in the interests of the children themselves, but also in the interests of the larger group of normal children.

Although the partial segregation of these children in Special Schools and special classes is already generally accepted the formation on any large scale of definite school with a definite curriculum is, and will continue to be controversial.

In the first place it must be realised that although backwardness is often due to irregular attendance, inefficient teaching, physical defects and defects of character, at least 60% of backwardness is due to innate factors.[1] In the Hadow Report on the Primary school, 'dull and backward' was taken as an Intelligence Quotient of 70 - 80 and 'more retarded' as 50 - 70; this would mean 10% of the children and, while the Report suggest that these children should be educated with the normal children in the Primary school, the retardation of these children increases with age. The number of backward children, of course, varies with the line of demarcation, for the abilities of each group merge into each other. Burt, taking backward children as those at 11 unable to do the work of even the class below their age, estimated the backwardness in a representative borough as '10% at the very lowest estimate.'[2] The Report of the Committee on Mental Deficiency in 1929 was

1. Compare The Distribution and Relations of Educational Abilities - Burt. P. 31.
2. P. 36.

even less sanguine. They showed that according to present methods of selecting Mentally Defective children, the number for the whole country should be 105,000 not the 16,500 who are at present treated. The summary in the Educational Year Book 1932 of the findings of the Committee is relevant.

"The report argues that a mere extension of the present system of special Schools for mentally deficient children is neither a possible nor a practical solution of the problem and that as the provisions of the Act have broken down and cannot be enforced, some fresh machinery must be devised".

"It is also recognised that there are large numbers of dull children for whom no special provision is made under the Act. These children who probably number some 200,000 or even 300,000 are not really capable of deriving full benefit from the instruction in the ordinary elementary school as now organised".

"The Report, therefore, recommends that in future the mentally defective child who is educable and the child who is merely dull, should be envisaged as a single group representing a single educational and administrative problem and that this group should be known as the Retarded Group -

"Special Schools shall no longer be specially certified though the substance of these valuable institutes shall be retained."

"The whole of the Retarded Group is to be kept without the stigma of a certificate within the public elementary school system with appropriate modifications of curriculum and organisation. The Retarded Group now an integral part of the public Elementary school system should have a break in their education at the age of 11 so as to bring the group into line with general educational administration".

It is frequently argued that the very last thing that should be done is to attach to these children any suggestion of mental inferiority yet it is difficult to see how this can be entirely avoided. Backward children to be educated in classes with normal children must be at least two years older than their fellows ~~this~~ which in itself is undesirable; and if special classes are formed within the school, teachers, specially trained for work with defectives are not available and the children tend to become neglected.

If special schools are formed, the backward children are among their equals, their backwardness is not constantly apparent, smaller class and more individual work is possible, specially trained staffs and an appropriate syllabus will enable the children to succeed 'to the best of their ability'. The curriculum of these schools must be determined with care. It is obvious these children will have to depend for a living on manual dexterity, rather than mental powers and a curriculum containing a preponderance of practical or even vocational work may be necessary. On this point Professor G.H. Thomson has no doubts.

"There is one thing which can I think be said with absolute certainty about vocational education. For very dull children below an intelligence quotient of '70 or even 75' it is the one hope for them, the one way in which they can be aided to take a self respecting place in the adult community. They, at least, should have after about 11 a definitely vocational training; not this time prevocational training but without equivocation a training for a trade. It is indeed positively criminal to attempt anything else with them, and on the whole we do help them in this way and with success. I am told that the percentage of employability

and of employment in the children leaving the schools of this sort for special children in London is far higher than the corresponding percentage in ordinary schools, which makes one wonder whether for many of the ordinary but not academically minded children similar treatment might not be most suitable provided that it is first made certain that they have chances of access to a more 'cultured' education".[1]

While this scheme of grouping is advocated for adolescent children, it must be understood that the groups cannot be rigid. Adequate provision for re-arrangement and transfer of children not only in theory but in practice should be a feature of the policy. To further this end, the curriculum of the upper stream in the senior school and the secondary school as also the lower strata and the more able in practical schools should have a measure of similarity, the differences being rather by depth and kind of treatment rather than differences in subject matter. The possibility of considerable readjustment at 13+ must receive recognition.

It follows that if reorganisation is to progress on these lines the problem of the treatment of various school subjects is capable of a general and more simple solution. It is proposed therefore to survey the importance of physics in the education of the adolescent in Industrial areas and to deal with the development of the subject in relation to three groups of children, the pupils in Secondary schools which will include Junior Technical Schools and Selective Central Schools; Senior schools including Day Continuation Schools; and thirdly Practical Schools.

1. A Modern Philosophy of Education.

CHAPTER VII

The History of Science Teaching in Schools.

The history of the gradual recognition for the need of introducing science into the curriculum for children of 11 - 16 is complicated by the rapid growth in the body of knowledge and the parallel lines on which instruction in science, developed Though all the pioneers of Science had their band of disciples, it was not until comparatively recent times that the systematic organisation of the different branches of the subject was contemplated. During the Renaissance the study of the classics led to a study of the work of Plato and Aristotle, but this study was characterised by a blind acceptance of their truths with no attempt to verify them by experient; Towards the end of the sixteenth century, however, the work of Francis Bacon & Galileo again recalled men to the study of facts and eventually broke down Aristotelean infallibility. The mediaeval universities, too, had set much store by the faculty of medicine, and had directed attention to the study of herbs and flowers; and, as the University developed and became more stable, the study of nature became more systematic. Thus at Oxford in 1669, a professor of Botony was appointed, and by the end of this century the growth in the knowledge of physics and chemistry had led to the formation of definite courses in these subjects. The Universities were still dominated by the classical tradition and the study was more by argument than experiment. The development of mathematics, however, was inevitable, thus preparing the way for a proper study of Mechanics and Physics.

Outside the Universities more rapid progress was being made. The early years of the 17th century saw the beginning of the Royal Society and through the Philosophical Transactions of the Society, the finding of scientific research became known. Throughout the century similar societies sprang

up in the provincial towns of which perhaps the Literary and Philosophical Society in Manchester and the Lunar Society in Birmingham are the best known. It was during this period, too, that the whole outlook of the country changed and as industry rather than agriculture became predominant, the importance of a knowledge of science and its application to industry and agriculture began to be recognised. In 1799 the Royal Institution was founded to further this end, an institution "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life". The institution was to be essentially practical, but the professors of the Institution, ~~says~~ Davy and later Faraday realised that practice and theory are one and general interest in scientific knowledge was stimulated by their research and fostered by the Friday and Christmas lectures.

The masses of the workers, too, were realising a need for knowledge and from 1800 onwards begins an extensive establishment of Mechanics Institutes. By 1850 there were 600 of these Institutes with more than 100,000 members. A Society of Arts was formed in 1852 with the idea of establishing an examination system whereby a definite status for admission to the institutes might be obtained. The examination was to be taken at 15, and papers in physiology, botany and chemistry were set. [redacted] But the worker had as yet no foundation of a general education, and the Institutes gradually became less effective. Connected with the Mechanics Institute, however, a number of Trade Schools were developed, the Islington School of Science and Art, the Liverpool Institute etc. The schools were intended to prepare

boys for apprenticeship in engineering, building, and manufacturing trades "by supplementing the work of the elementary school with instruction in practical mathematics and science".

The Great Exhibition of 1851 emphasised the fact that England was lagging behind not only in the provision of elementary education, but ~~was seriously hampered by a lack of~~ also in facilities for scientific training and in the application of scientific methods to industry. In the same year as the exhibition the School of Mines was founded which in 1863 combined with the Royal College of Chemistry and became the Royal College of Mines. In the year following the Great Exhibition the Department of Practical Art was established and 1853 a Department of Science was added. The purpose of the department was to form schools of instruction in subjects applied to local industries, but in course of time the original idea was lost sight of and the Department encouraged more the collection of scientific facts and the development of artistic skill.

A series of examinations were instituted and a special grant was paid to the school in respect of successful candidates. In 1861, 82 science classes were examined and in 1870 the number had increased to 2,204,. At first however, little progress was made, for, although an Honours School in Natural Science ~~was~~ had been formed at Oxford in 1850, and a Tripos at Cambridge the following year, there were very few suitable teachers available. The Department therefore instituted a qualifying examination for teachers in 1860.

In an attempt to increase the efficiency ~~of~~ elementary schools the Revised code was put into force in 1861, and as this came to mean that teachers were paid according to the number of candidates who passed the required examination, it became a growing practice to augment the education grants by grants from the Science and Art Department. Thus the upper standards in

the elementary schools were supplied with necessary science information to take the examinations of this department.

To widen the curriculum of the elementary schools, the Code was modified and specific grants for two extra subjects were instituted. The extra subjects were geography, physical geography, algebra, grammar, natural science, natural philosophy, political economy, and languages. About this time, due largely to the influence of Huxley, object lessons were introduced into the curriculum of the London schools and visiting teachers were appointed. In 1895 the Code made object lessons compulsory in Standards I, II, and III. In many schools, at this time scientific studies were dominating the curriculum, for Under Regulation in 1872, the Organised Science schools ~~were~~ had been created. These schools were required to conform to a fixed curriculum for 13 hours of the week. This was made up of 5 hours mathematics, and 8 hours for chemistry, drawing and practical geometry. Of the remaining 10 hours of the week, 2 hours could be used for manual instruction, and another 2 hours for mathematics, the remaining 6 hours was for English and general school subjects.

The introduction of science teaching was not confined to elementary schools, for the education in Public and endowed schools was being investigated. The Public Schools Commission and the School Inquiry Commission of 1860-70 showed that of the 128 schools examined only 18 schools had any provision for science. In their recommendations they suggested that all schools should have at least one hour a week for science. The Report of the Devonshire Commission in 1875 was more constructive, and dealt at some length with the difficulties of forming science sides.

The Report recommended:-[1]

"(1) That in all Public and Endowed schools not less than 6 hours a week on the average should be appropriated for this

1. History of Science Teaching in England. - Turner.

purpose (Scientific Instruction)

(2) That in all General School Examinations not less than $\frac{1}{6}$ of the marks be allotted to Natural Science.

(3) That in any leaving Examination the same proportion should obtain.

The growth of external examinations, the College of Preceptors, the Oxford and Cambridge Locals 1860, and the Matriculation examinations also led to a more general inclusion of science in these schools. The classical tradition dies hard, and the general acceptance of science in the curriculum was due, in no little measure, to some of the great headmasters of this age, Dr. Arnold and Dr. Temple at Rugby, Dr. Thring at Uppingham, and Dr. Sanderson of Oundle. Due to the rise of the modern Universities the supply of suitable teachers also increased towards the end of the century, and by 1904 it was necessary for Training Colleges to have proper laboratories.

Thus at the end of the 19th century, the place of science in the curriculum was definitely assured, indeed in the organised Science Schools overshadowed the whole syllabus. Fortunately in 1900, the notorious Cockerton, judgement, made these schools illegal for the purposes of the Elementary Education grant, and though an act was passed to legalise the school for one year, with the 1902 Education Act these schools were brought under the Secondary School scheme as Secondary Schools, Division A.

In 1904, grants for individual subjects were abolished and a single grant for a four years course was given. With the abolition of the grant, Science no longer held an exalted place, and the time given to it, was considerably reduced. For a secondary school to be efficient however, science was to be part of the curriculum. "Instruction must be given in at least

two distinct branches of science for each of which adequate laboratory accommodation etc. must be provided. It is not necessary that the same branches of science should be studied in each year of the course but the selection should be such as to secure continuance and progressive instruction in science suited to the special circumstances of the school." The regulations were unaltered until 1917 when it was made a duty to supply sufficient apparatus for experiments by the pupils.

"Instruction in science must include practical work by the pupils and for girls over 15, domestic subjects such as needlework, cookery, laundrywork, housekeeping, and household hygiene may be substituted, partially or wholly for science and for mathematics other than arithmetic".

In this year, too, the external examinations were standardised and to obtain a certificate it became necessary to pass in mathematics or science.

In elementary schools the Board have always insisted on science, but have preferred to allow schools to exercise their understanding, rather than specify a syllabus.

The position of science being secured, more attention was paid to the method of teaching the subject. In 1899, the British Association reported on the existing method of teaching the subject and under the direction of H.E. Armstrong, warmly advocated the Heuristic method, and to further the study, a separate section of the British Association on Educational section Section L, was formed in 1901. In 1918 the Report on Natural Science was published and many of the progressive aims of this report still remain to be fulfilled.

CHAPTER VIII

The Place of Science in the Curriculum.

Although science is now firmly fixed in the curriculum it is none the less desirable to appreciate clearly the grounds on which its claims are based. This is additionally necessary and valuable since the progress of educational research has considerably modified the attitude towards the subject. By tracing the gradual inclusion of science in the curriculum during the 19th century it was clear that the demands were in a measure from outside, but as science gained a secure foothold its presence was explained by the current educational theories. The Faculty Psychology which had hitherto denied science a place was now used to explain its existence. The discipline of the subject was stressed and the form was advocated at the expense of the content. Thus in supporting the claims of science in the Schools the Inquiry Commission states "It quickens and cultivates directly the faculty of observation which in very many persons lies almost dormant through life, the power of accurate and rapid generalisation and the mental habits of method and arrangement, it accustoms young persons to trace the sequence of cause and effect, it familiarizes them with that kind of reasoning which interests them and which they can promptly comprehend and it is perhaps the best corrective for that indolence which is the vice of half awakened minds and which shrinks from any exertion that is not, like an effort of memory, merely mechanical."[1]

The British Association Committee in 1889 were equally insistent on this disciplinary value of science. Science was an "effective and attractive method of training the logical faculties" and develops "powers of accurately ascertaining facts and of drawing correct inferences". Yet the philosophy of Locke faded with the century. More and more it became evident that such a philosophy could never enrich the curriculum. If the

1. Report of the Schools Inquiry Commission 1864. Vol. I.

mind could be trained, then a wide diversity of subjects was unnecessary, the substance of a study had little value and the ideal subject might be found by elimination. But character and culture are many sided and to cultivate and foster these there could be no such restriction of a course of study. Education must be concerned not only with the training of the mind but also the nourishing of the mind.

Experimental evidence, too, revealed the fallacies in such a theory. Results showed that the faculty of observation in one subject did not necessarily carry over into another study or into daily life. The conclusions to the experiments are these: "that specific mental training has a certain measure of general effect; that the amount of this general transfer is by no means great - it is much smaller than was believed by the educationalist of twenty years ago and much smaller than is believed by the layman of today; that the amount of transfer from one mental function to another is as a rule proportional to the similarity of the material dealt with and of the mode of dealing with it; that separate acts of observing are not necessarily similar sets and there is not necessarily an overflow of training from one to the other (the same is true of the other faculties); and that although we do not understand fully the considerations in which transfer takes place it is probable that it depends largely upon the engendering of favourable habits and attitudes of mind and on the conscious and sub-conscious formation of ideals"[1].

Though the explanation of the place of science was shaken, the demands for instruction in science were even more insistent and in this lies the key to its recognition. The world in which the pupil must take his place has been rapidly changing. The applications of science to industry, to commerce

1. The Changing School - Ballard. P.60.

and to agriculture have altered the tread of civilisation, and as science is as yet in its infancy the changes of the future are likely to be even more revolutionary. Education, as Herbert Spencer indicated, is for complete living and to understand and direct these changes, to fit the pupil into this new environment the education of the adolescent must undergo corresponding changes.

"Experimental science has been the outstanding fact of the last century and a half, and during this period it has created a new industrial structure of society and produced startling changes in the social needs and relationships of life and it is with these altered conditions that education will have to deal".

In his work and in his leisure the citizen is in daily contact with natural phenomena and the applications of science, and if the progress of civilisation is to be appreciated; if interest is to be stimulated; if judgment is to be sound and character to be moulded so important a feature of present day environment cannot be ignored.

Nor is it sufficient to regard science as a collection of useful and interesting information, for scientific knowledge is not ~~constant~~ stable and is constantly being modified as mankind grows in power. Thus the knowledge of science must not only form the background for further advance but it must show how man can change and adjust himself to his environment. Science must be studied in the light of human endeavour. To educate the pupil to take his place in the community and to equip him for a life of understanding and appreciation of nature, its beauty and marvellous variety, the struggles of mankind to learn its mysteries; the zeal of Pasteur, the untiring research of Faraday, the hopes and disappointments, these must be used to nurture the complete man.

1. Sanderson in The Modern Teacher. P.139.

'I invite you accordingly to think of science not merely as a body, or bodies, of useful knowledge, nor merely as a mental discipline, but as one of the typical forms assumed by the creative activity during the long history of its development.'[1]

It is on this firm basis that the study of science must rest. With the change in civilisation, science must take its place, an important place, in the scheme of a liberal education, for science and the humanities are the warf and woof of the fabric of modern life. "I wish to urge" says the Bishop of Birmingham, "that science by giving us a new knowledge of man's origin and place in the Universe has become a most important factor in humane studies"[2]. Literature as the Hadow Report indicates should by treated as a form of art in which life has been interpreted and this too is the function of science. Science has its romance and wonder, its literature and history, and it is by these no less than by its utility that science is vital to the proper education of adolescent youth.

1 Sir Richard Gregory - Presidential Address to Science Masters Association 1928

2. Presidential Address 1926.

CHAPTER IX

A Constructive Criticism of Present Methods of Teaching Science.

CHAPTER IX.

A CONSTRUCTIVE CRITICISM OF PRESENT METHODS OF TEACHING SCIENCE.

While the enthusiasm for science in the 19th century was directed largely to the establishing the subject in the curriculum of all schools, attention in the 20th century has been more concerned with the teaching methods. Now after some twenty years of the study of the subject in the schools, it is time to take stock of the position and to see how far the study of the subject has been justified. The evidence suggests that the present position of science in schools can only be viewed with some misgiving and,as yet, the results of its inclusion in the curriculum have fallen short of the visions of its early advocates. There is no gainsaying that in all too many schools of the present day the study of science has developed into a spiritless performance and often the eager enthusiasm and spontaneous curiosity of the pupils has been

used to no account.

'A generation of science teaching has produced a very disappointingly small dissemination of scientific knowledge of an available kind among our people - - - and has edified and instructed far less than was reasonably to be expected from a movement that has been carried out for so long and with such vigour'[1].

Bode in Modern Educational Theories is equally emphatic.

"The reformers, who led the struggle to secure a place for science in the curriculum entertained roseate hopes which have ended largely in disillusionment. The study of science was expected to prove a panacea for all our educational ills. The high purposes of liberal education would then be effectively realised. Eventually the sciences were admitted to the curriculum. What has been the result? In spite of laboratories and innumerable courses in college and secondary schools, do not the purposes still remain largely unrealised. What after all for the average youth has the prevailing study of physics, of chemistry and of biology to do with a liberal education. The methods currently employed are those of formal vocational training; high school and college teachers organise their work as if their sole business were to prepare forthcoming specialists in teaching, medicine and engineering. Once in a generation each institution may get a real teacher of science from the standpoint of inspiration, insight and culture - in a word liberal education the rank and file are technicians only. The popular verdict is that science pure and applied is not yet in practice a feature of a liberal education"[2].

How far then are these criticisms justifiable and in what way may such fears be dispelled in the future? Science in schools is still in its first youth; experience and

1. Professor Smithell - Presidential Address to Science Masters Association 1924
2. Modern Educational Theories - Bode. P.123.

experiment are limited; and teaching methods still retain some trace of the forces which successively determined ~~the~~ its position in the curriculum, ~~forces~~ and which must be considered in any schemes for future progress.

In the Universities as has been indicated, physical science first saw light as the handmaid of mathematics, the tendencies grew to clothe all scientific knowledge in the garb of mathematical formula and to limit practical work to the determination of 'constants'. It was against this tendency that Maxwell in his inaugural address at Cambridge in 1871 spoke so strongly.

"This characteristic of modern experiments - that they consist principally in measurement - is so pronounced that the opinion seems to have got abroad that in a few years all the great physical constants will have been approximately estimated and that the only occupation which will then be left to men of science will be to carry on these measurements to another place of decimals'.

"If this is really the state of things to which we are approaching, our laboratories may perhaps become celebrated as a place of conscientious labour and consummate skill but it will be out of place in the University and ought rather to be classed with the other great workshops of the country where equal ability is directed to more useful ends".[1].

Yet this mathematical tendency was later carried over into the schools and there was emphasised by the type of papers which was set in the existing external examinations. In these examinations, the examiners, desirous of attaining an objective standard of marking, limited the questions more and more to those types which admitted of a mathematical solution. The correlation between mathematics and science must be as close as

1. History of Science Teaching in England—Turner. P. 132

possible, indeed the Committee of the Mathematical Association has suggested that these subjects should be taught by the same master but this does not mean that the only branches of science to be taught are those which involve calculation. Furthermore in the initial stages of science, the expressing in algebraic formula of the results of simple experiments, tends with young children to confuse rather than to illuminate and the chilling effects of a first year course in 'practical measurements' are still pronounced, teaching the child to measure accurately we must not deprive the child of the desire to measure anything.

In the elementary schools on the other hand science was introduced by a system of object lessons and, in furtherance of this idea, Huxley drew up a valuable series of lessons in Physiography, the influence of which was so great that in the examinations for Organised Science Schools in 1881, 6901 children took physiology, 411 Botany and 51 mechanics. But the method of object lessons was also doomed to failure. The lessons were generally designed to be complete in themselves and rarely left the pupil with the desire for further investigation. The intention of the teacher was to give information rather than to organise knowledge for the acquisition of more knowledge; he dealt with facts rather than principles, and, as object lessons became more generally used, even the interests of the child were forgotten.

The lessons often deteriorated into a list of technical names and details.

In 1889 the teaching of science in schools was the subject of an Enquiry of the British Association and the resulting Report largely due to the influence of Professor H.L. Armstrong warmly advocated the Heuristic Method. Professor Armstrong explains the method in the following words.

'It is in no sense mere opinion on my part but a conviction gradually forced upon me and established beyond all doubt by actual trial and observation during many years past, that the beginner not only may, but must be put absolutely in the position of an original discoverer, and all who properly study the question practically are coming to the same opinion. I find young children are delighted to be so regarded, to be told that they are to act as a band of young detectives.

It is of no use for the teacher merely to follow an imaginary research path, the object must ever be to train children to work out problems themselves and to acquire the utmost facility in doing so. Of course, the problems must be carefully graduated to the powers of the children scholars and they must be insensibly led; but do not let us spoil them by letting them know definitely in advance what to look for and how to look for it, such action is simply criminal". The whole policy of the teacher's duty is summed up in one little word yet the most expressive in the English language, it isto to train the pupils "to do".

The heuristic method, it is clear, is essentially a method of discovery, every experiment becomes a piece of research, the teacher though he organise the work initially, remains in the background assisting or suggesting works of reference only when the pupils can make no further progress. The laboratories become workshops, 'mysterious pieces of apparatus' are replaced by 'raw material, tools ba ances and simple devices.' Indeed the balance must says Professor Armstrong 'become an instrument of moral culture and be treated with care and reverance'.

At this juncture the heuristic method was invaluable for the attention which it drew to practical work and the emphasis that it laid on experimentation. Thus instead of

science talks by the teacher or a lecture - demonstration it became the growing practice to insist on experiments performed by the children.

As the method became more popular it was realised that a strict adherence to heuristic principles was not without its dangers. In the first place, with the desire to use this method of discovery, the syllabus in science became more and more limited to those branches where such a method was most fruitful. In short, the sciences where experiments with simple apparatus and experiments which could be completed within the period of the lesson. Thus instead of the broad physiography of Huxley science became restricted to physics and chemistry. In 1925 of the thirty-nine representative schools which were a basis of the Enquiry of the Board of Education only three offered any branches of science other than these two subjects; and, furthermore, even in physics and chemistry whole sections were entirely neglected.[1].

'So it has come about that the majority of pupils in our Secondary Schools never get beyond the stage of determining specific and latent heats in their course of physics and they leave school knowing nothing of the principles of such everyday instruments and appliances as field glasses, electric bells, telephones, periscopes, dynamos, motors, and many other applications of physics met with in everyday life'[2].

It is clear that an exclusive use of this particular method is not now advisable. The pupil, in his school career, has not sufficient time to investigate everything from first principles, nor, indeed, is such a training desirable; for each generation must progress not only by the successes but also the failures of the previous one and education must in part be a leading past 'blind alleys'.

1. Report of an Enquiry into the Teaching of Science in Secondary Schools — Board of Education.
2. The Teaching of Physics in Schools — Physical Society. P. 10.s.

The Great War brought home to all classes of people the need for a deeper knowledge of developments of science and in 1916 a committee under Sir J.T. Thomson was appointed 'to enquire into the position occupied by Natural Science in the Educational System of Great Britain and to advise what measures are needed to promote its study".[1]

The position of science was thoroughly investigated and a report was issued in 1918. The findings of the Committee are still well in advance of educational practice and merit full consideration when any scheme of science, is designed.

"We consider that the conventional curriculum is in great need of reform in respect of two important points (a) the choice of subjects to be included and (b) the manner of treating them.'

'It is agreed on almost all hands that the customary course which is the growth of the last 20 years has become too narrow not only because physics and chemistry are the only sciences included in it but because the choice of subject matter within these sciences is unduly restricted. Further it is out of touch with the many applications of Science. The principles are often taught without reference to the phenomena of nature which they explain; the course does not satisfy the natural curiosity of the pupils' - - - "Again in many schools the course is planned as if its sole object were to lay the foundations for specialised study in Science at a later period. But if nothing is built on these foundations the time may have been spent to little purpose, many of the boys will give up the study of Science when they know but little of the scientific principles which underlie the most familiar natural phenomena or of the most important applications of Science to the service of man" - - -

"For the last twenty years, the attention paid to

1. Natural Science in Education - Terms of reference

laboratory work has been the outstanding feature of Science teaching in English Schools and results of great value have arisen from it". But after referring to the time when little or no practical work was done, the Report continues . . . "But" in the last 20 years circumstances have altered; laboratories have multiplied and it has become the practice to make the laboratory work the central feature in school science. This change in point of view has both good and bad results. On the one hand it has brought home to many boys and girls the fundamental notion of an experimental science; that answers to questions on its subject matter can be got directly by experiments which they can do themselves, they have seen how a series of experiments leads up to a result of one experiment suggests that another is needed, they have in fact learnt something of the experimental method of the sciences. Such teaching is of the greatest value and any change which would diminish its effectiveness would be a step in the wrong direction". "But on the other hand there have been unfortunate consequences; many teachers have become so dominated by the idea of the supreme value of experimental work that they have left on one side and neglected those sciences which do not lead themselves to experimental treatment in school; the tendency has been to restrict the work to parts of physics and chemistry in which the boys can do experiments themselves. We are driven to the conclusion that in many schools more time is spent in laboratory work than the results obtained justify. We do not underrate the importance of such work, on the contrary we regard it as an essential part of science teaching. But sometimes the performance of laboratory exercises has been considered too much as an end in itself" - - - often exercises succeed each other without forming part of a

continuous or considered scheme for building up a boy's knowledge of his subject. Sometimes a very imperfect experiment is done by all the pupils, when the point which it brings out could be better illustrated by an experiment performed by the teacher on a scale and in a manner which would not be possible for a whole form."[1]

The present ineffective teaching in science seems to be mainly due to three factors, firstly, the lack of understanding of the importance of the liberal aspect of science; secondly, the difficulties of maintaining the balance between the subject matter and methods; and thirdly, the maladjustment of the logical and psychological aspects of the subject. It is clear that if science is to form part of a liberal education, science must be studied in more effective relations with life. The outlook of science must be broad and science must become an intimate factor in human development. The wonder and delight in natural phenomena must always be present and the pupils must see how man has discovered the secrets of Nature and has used the knowledge for the betterment of his fellow creatures. Furthermore a science course must bring to the pupils a realisation that the ways of Nature can only be found after careful search and accurate investigation. The study of science as the Report on Natural Science points out, has two functions (a) it should train the mind of the student to reason about things which he has observed for himself and develop his powers of weighing and interpreting evidence (b) it should also make him acquainted with the broad outlines of great scientific principles, with the way in which the principles are examplified in familiar phenomena and with their applications to the service of man. It is clear also that while the claims of science do not rest on its utility, the subject matter

1. Natural Science in Education. P. 53.

must not be sacrificed to any particular method of teaching science. Any scheme of science must at all costs retain the eager interest and natural curiosity of the pupils. In general this will involve a departure from the strict logical order of the subject, for the viewpoint of the pupil is not the same as that of the specialist in the subject. This was stressed in the Report of the British Association in 1922: "The Science to be taught should be science for all and not embryonic engineers, chemists or even biologists; it should be science as part of a general education, yet most of the science courses in secondary schools are based upon syllabuses of the type of university entrance examinations - syllabuses of sections of physics, or chemistry, botany, zoology and so forth - suitable enough as preliminary studies of a professional type to be extended later, but in no sense representing in scope or substance what should be placed before young and receptive minds as the scientific portion of their general education"[1].

We may conclude, therefore, that an effective course in science

(1) must be framed to give the pupils a broad outlook and show that science isintimately linked with everyday life, and

(2) must involve in the later stages a more detailed study of one or more branches of science so that the pupils may appreciate and understand experimental and scientific methods.

Similar conclusions were arrived at by Sir Richard Gregory: "The chief reason for the narrow character of most science courses in schools is the small amount of time available and the demands made upon it in recent years by laboratory work. The substance of instruction has suffered from the concentration upon method, and the right adjustment of the conflicting claims of the two in a truly educational

1. British Association Report. 1922.

course has yet to be found.

Let a broad general course of science be followed independently of the intensive laboratory work in particular branches designed solely to create and foster the spirit of experimental inquiry by which all scientific progress is secured. In this way it should be possible even with the present limitations of time to provide training in method as well as wide knowledge"[1].

1. British Association Report 1919.

CHAPTER X

Science in Industrial Areas.

The conclusions that have been arrived at for the framing of a science syllabus are easily compatible with the idea of introducing bias. Bias, it was found, should be introduced in the later years of the school career, while, in science, it is at this stage that a more detailed study of particular branches is needed. It seems clear, therefore, that schemes of science in schools for adolescent children should be divided into two parts. First a more general section to foster a broad outlook, and in the second stage, while there should be no narrowing of the general scope, one or two branches of science should be studied in more detail, and these branches will be determined by the particular bias of the pupil. As the Report of the British Association stated: "The science curriculum is too often framed so as to have little or no connection with the needs of any occupation which our pupils are likely to follow when they leave school. They are in a great majority of cases far too academic in their outlook, not more so, it is true than other branches of the curriculum, but it should ever be remembered that it is just in this respect that science has far greater opportunities than other subjects, let us see that our opportunities are not neglected."[1].

How then should these general principles be modified by the particular environment, industrial areas, with which we are concerned. In industrial areas, the interests of the pupils are directed more to those branches of science which form the basis of manufacture rather than those which affect agriculture. Thus while the wide view of science must be retained, the main background must be those branches which are more readily appreciated by the pupils in this environment. In industrial areas there is no doubt that

1. School Science Review. Vol XI. P. 238.

physics and chemistry must have an important, though by no means an exclusive, part in the general science scheme. "Physics and chemistry should rightly claim first place in the post-nature study course, not only because they play a very important part in most of the other natural sciences and also because their range if liberally interpreted covers so many of the things man meets with in everyday life."[1] Mr. Westaway, H.M. Inspector of Secondary Schools is also of this opinion: "That physics and chemistry will always be the main subjects is inevitable. They form the foundation of all other branches of science. But this does not mean that biology should be excluded as is often the case. Biology is an essential subject in any school science course"[2].

The general principles for an effective scheme may be taken a step further, chemistry is based primarily on the physical properties of materials and therefore in the initial stages of the course the framework should be physical science. As the Hadow Committee suggest: "In modern schools situated in districts with one industry or group of industries special attention might be devoted to elementary physics and mechanics"[3].

To sum up, the science scheme for reorganised schools in County Boroughs and industrial districts should have two main divisions.

I. A broad general course in science for the first and second years, 11+ to 13+. The main theme of this part of the course should be physical science, but at appropriate points extensive inroads into other sciences should be made. This part of the course should be a more or less complete whole, providing therefore, a sound basis for more detailed

1. Teaching Science in Schools — Brown. P123.
2. Science Teaching — Westaway P. 66.
3. The Education of the Adolescent. P. 223

TABLE 14 THE DIFFERENCE IN THE AVERAGE MARKS IN PHYSICS FOR BOYS AND GIRLS IN CERTAIN MIXED CLASSES.

FORM.	1929. EXCESS OF AVERAGE MARK FOR BOYS OVER THAT FOR GIRLS. EXAMINATION.		SEX OF TEACHER.	1930 EXCESS OF AVERAGE MARK FOR BOYS. EXAMINATION		SEX OF TEACHER	1931. EXCESS OF AVERAGE MARK FOR BOYS. EXAMINATION		SEX OF TEACHER.
	HALF YEAR	FULL YEAR.		HALF YEAR.	FULL YEAR.		HALF YEAR.	FULL YEAR.	
UPPER SIXTH.	21	HIGHER.	M	24·0		M	6·8		M
LOWER SIXTH.	6·5	SCHOOL CERT.	M	8·7	H.S.C.	M	5·6	H.S.C.	M
UPPER FIFTH A	4·2		M	18·4	S.C.	M	3·8		M
" " B	7·4	SCHOOL CERT.	M	—			-3·7	S.C.	M
" " C.	-3·0		M	—			—		
LOWER FIFTH A	8·1	16·3	M	0·7	15·0	M	14·8	6·2	M
" " B	9·3	7·9	M	10·0	3·1	M	16·3	3·4	M
" " C	5·2	-8·1	F	—	—		—	—	
UPPER FOURTH A.	-2·2	0·7	M	1·8	17·2	M	6·8	7·9	M
" B	-0·3	~~1·8~~	F	8·1	6·5	M	3·9	7·1	M
" " C	5·1	~~-8·4~~ 11·7	F	12·1	14·4	M	6·9	-3·6	M.
LOWER FOURTH.	-1·6	~~-8·2~~	F	6·8	4·5	F	10·7	8·6	F
THIRD FORM A	10·2	5·2	F	11·7	17·4	M	9·3	17·5	M
" " B	6·2	2·4	F	-3·7	-0·3	M	-5·2	6·9	M
" " C	21·6	7·3	F	—	—		—	—	

study of particular branches of science and also facilitating transfer between the schools.

II. At 13+, after the second year, though the course in science must still be wide, one or more branches of science will be chosen for more intensive inquiry and the work in these subjects will be governed by the ability and particular bias of the children. For the academic group physics, chemistry and biology must receive equal consideration. For the industrial group physics and to a less degree chemistry will be chosen almost without exception. Physics to this group is a necessity for the physical principles underlie all modern development in mechanical, electrical and marine engineering. Chemistry, too, plays an important part in present day manufacturing processes and with more intelligent children this subject should also be studied in more detail.

In mining areas geology must be an important feature of this part of the scheme.

For the commercial group the more mathematical outlook of physics will result in a preference for chemistry and biology.

The sex of the pupils will also be a factor in determining the type of science chosen. The difference in the average marks in physics of boys and girls in mixed schools for a number of years is shown in Table 14 . Table 15 gives the difference in the marks in physics in the School Certificate Examination. While one is necessarily cautious in drawing any general conclusions, it seems that whether girls are taught physics by a master or mistress, they meet with less success in the subject than boys do. Attempts have been made to emphasise still more domestic

TABLE 15. THE DIFFERENCE IN THE PERCENTAGE OF BOYS' AND THE PERCENTAGE OF GIRLS WHO PASSED WITH CREDIT IN THE SCHOOL CERTIFICATE EXAMINATION.

SUBJECTS	1923	1924	1925	1926	1927
	Subjects in which girls excelled.				
Scripture	28·0	25·2	23·8	15·2	24·0
English	19·3	16·9	17·0	17·0	19·4
History	5·3	4·3	6·5	5·4	5·6
French	2·4	2·9	1·7	2·3	3·7
Latin	2·3	5·1	2·7	1·9	-2·3
	Subjects in which boys excelled.				
Physics	19·2	21·2	18·0	19·8	22·6
Mathematics	17·3	18·5	18·7	19·0	21·6
Chemistry	14·3	6·9	9·0	8·2	4·8
Geography	·9	3·4	5·5	5·7	6·2
Art	4·2	3·6	2·5	−0·1	·4.

From Secondary School Statistics — Crofts Jones.

applications of physics, so as to sustain the interest of the girls, but the difference in the average marks is still noticeable.

It seems therefore that for girls biology and chemistry will be the main subjects studied in the second part of the course.

"We suggest that science courses for girls in Modern Schools and Senior classes should in their later stages frequently have biological trend, though occasions should be taken to impart to the work much of the exactness and discipline of the experimental sciences and to train the girls in habits of careful observation and clear thinking. The work should not be confined to botany as the study of simple forms of animal life can under a wise, skilful teacher be made an admirable means of widening and disciplining the pupils sympathies and giving her broad hygienic ideals and a knowledge of nature which may increase her happiness and her efficiency as a human being."[1]

1. Education of the Adolescent. P. 224.

CHAPTER XI.

General Method in the Teaching of Physics.

From time to time various methods of teaching physics are warmly advocated. When the subject was first introduced into the curriculum, the object lesson or lecture-demonstration was largely used. It was found, however, with this method that the interest of the child was frequently lost, the pupil gained no idea of the importance of accurate experimentation, and the value of individual work was entirely lacking. The reaction against this state of affairs resulted in the adoption of the heuristic method and the lecture-demonstration disappeared. Though the lecture-demonstration was not in its entirety in the true interests of scientific instruction, the method has still a place in physics teaching. As the Report on Natural Science pointed out this type of lesson is frequently of value in dealing with branches of the subject where more elaborate experiments are needed. Personal experience has shown that the lecture demonstration is valuable, in fostering a broader outlook in the subject and in stressing the humane aspect, the applications and history of physics; ~~and~~ for arousing interest - 'appreciation lessons';and for the general revision of sections of the work.

The heuristic method - the method of discovery - has been dealt with in some detail. It was shown that the exclusive use of this method of instruction limits both subject matter and the general syllabus, but the spirit of enquiry which this method develops is invaluable in science work. There is no doubt that 'discovery' should be the basis of all experimental work by the pupils.

The historical method has many followers. In this method of teaching, the children ~~proceeds with~~ fosters work on a syllabus based on the historical development of the subject. For

tracing the development of modern physical theories with senior pupils this scheme has been found very useful; but with young children it is generally more effective to use as a starting point modern and everyday applications of physical principles. The historical method, however, can be used with advantage in some parts of the course and photographs and models of original apparatus do much to dispel the common impression that research is only possible with expensive instruments.

The project method of teaching in schools must receive full consideration. As Sir J. Adams says: "One of the most characteristic of modern tendencies in schools is the general recognition of the purposive element. There is a very wide acceptance of the view that pupils should always have a clear idea of why they do certain things in school"[1]. In this method, a project or 'problematic act' is created and the whole energies of the pupils are directed to this end. This involves a complete departure from the tradition of division of the curriculum into subjects, knowledge of particular subjects is gained by their interaction with the main problem.

In capable hands the project method engenders much enthusiasm but it is clear that some minimum of system is necessary, and unless main principles are to be tied up with narrow examples, expansion and generalisation are necessary. It seems undesirable, both from a practical and theoretical point of view to depart entirely from the logical basis of the subject, though it must be realised that the logical order is something to be attained rather than the starting point for the children.

1. Modern Developments in Educational Practice.

"If we overlook the fact that science means a specific type of organisation we are in danger of dissipating our energies in the study of science by limiting ourselves to accumulation of a mass of more or less interesting details. We then become acquainted with scientific facts but we do not become introduced to scientific procedure or method. It is science with 'science' left out"[1].

Experiment shows that smaller projects within the subject may be used with great advantage and the ideal problem is such as to involve considerable research by the pupils but not so extensive that the pupils lose interest.

"No doubt we keep our subjects too rigorously apart as things stand and the proposed method will do something to develop a better understanding of the inter-relations of the various branches of knowledge. But this advantage can be secured by a very partial adoption of the method of Projects and it is very doubtful how far we can ever accept the pure Stevensonian doctrine of natural setting."[2].

1. Modern Educational Theories' - Bode. P91.
2. Modern Developments in Educational Practice - Adams.

Personal experience has shown, that with the humane aspect of science clearly in view, variety of treatment gives most successful results, and the particular method used must be determined by the attitude of the children and the subject matter to be dealt with. Thus in physics the building up of a common pump is very successful in a demonstration lesson. Archimedes Principle can be effectively taught on heuristic lines, ~~and~~ while the project of fitting up an electric bell between the laboratory and preparation rooms forms an admirable introduction to electrodynamics. In general procedure the interest of the pupil must first be aroused by directing his attention to some application of the particular principle, and while this can be done by a general discussion, the children are always more impressed by concrete examples; thus curiosity and enthusiasm are more spontaneous if a visit is made to some works where the main principle is shown e.g. a visit to a Power Station as a beginning to the study of the dynamo. Secondly the underlying idea in the application must be deduced and the general principle 'discovered' by suitable experiments. Thirdly, the main principle having been established, it must be extended to cover as many other applications as possible. Finally attention should be directed to the first discovery of the law with details of the life of the discoverer and the way in which the discovery has influenced the progress of civilisation.

The following scheme for broadening the outlook has given satisfactory results. After the general principle has been established a large sheet of cardboard about 2 ft. square is fastened on the wall of the laboratory. On this sheet the principle is stated in simple language, a sketch of the

DIAGRAM OF SCIENCE SHEET.

SHIPS AND FLOATING BODIES.

ARCHIMEDES' PRINCIPLE

Statement of Principle

Account of an Experiment which shows the principle

PLIMSOLL LINE AND LOADING OF SHIPS.

R.101. DISASTER. (Loss of Buoyancy).

FLOATING DOCKS.

STORY OF ARCHIMEDES.

HOW TO MAKE A CARTESIAN DIVER.

PHOTOGRAPH OF A FLOATING DOCK LEAVING SOUTHAMPTON FOR AUSTRALIA

SINKING OF THE SUBMARINE L. 2.

apparatus used and an account of the general experiment is attached. The sheet is put in the charge of a pupil - with young children the 'keeper' of the particular record - and the pupils are encouraged to collect information bearing on the principle, historical details, photographs, newspaper cuttings etc. and these are pasted on the sheet. A diagram of a typical sheet is shown.

The methods of laboratory work in physics and general science are also subject to much controversy; on the one hand the value of individual work with each child doing his own experiment, and, on the other hand, the whole class performing the same or a similar experiment. The advantages of the individual method are that duplication of apparatus is to a great extent eliminated, every pupil is occupied and each proceeds at his own pace. With this method however, it is impossible for all the pupils to follow the logical order in the experimental work, and, unless each group of apparatus is stored separately, or numbered to coincide with the card of instructions, much time is lost each period in distributing apparatus. Again it is difficult for the teacher to supervise and help each of the twenty or thirty pupils, and therefore unless the class is of special ability the instructions must be very detailed and contain a large measure of theory.

In the collective method, the duplication of apparatus is a serious drawback, and further, the progress of the class is limited to that of the slowest pupils. Yet in a general discussion of a class experiment, the full value can be brought out, the results can be compared and if numerical, the most probable value determined, while many interesting points may have escaped general notice.

In practice a combination of both methods has been

successfully used. The pupils work in pairs and the whole class is divided into four or five teams. After the main ideas have been established the section of the work is divided among the various teams and the pairs in each team work on similar experiments. For example, when dealing with the atmosphere the work is divided into four parts, air pressure, historical development, weather forecasting, causes of winds. A healthy spirit of emulation is aroused and lecturettes by each team are possible.

CHAPTER XII.

Physics in the Reorganised Schools.

The Committee on Natural Science suggested that the minimum allotment to science in Secondary Schools should be four periods in the first two years of a five years course, and six periods in the remaining three years. Although it was clearly stated that this should be the minimum such an allotment is now the average portion of the school week devoted to science. It is desirable that in industrial districts, more especially, the science periods should be increased to a minimum of six periods a week throughout the school course. At present the time in the first two years is usually divided between physics and chemistry, but in the best interests of science teaching a general science course, as has been indicated, is more advantageous. If such a course is instituted the pupils should be taught by the same teacher during this part of the course.

The following scheme has been found to work well in practice.

Scheme for general science for the Secondary School Group 11+ to 13+ .

First Year.

Term I.

(a) 'Appreciation' lessons.

(b) Physical properties of common substances, and how these properties determine the uses of the substances. (Each child throughout the term collects information about one substance and at the end of the term the information is organised on broad lines).

(c) Effects of heat on common substances, burning, melting and boiling, expansion.

(d) The thermometer - Galileo.

(e) Melting Points and Boiling points (solders, fuses, metals, from ores etc). Distillation, solution and crystallisation.

(f) Convection currents in water - Hot water systems.

(g) Freezing of water - Bursting of pipes - freezing of ponds - denudation.

TERM II.

The Atmosphere.

(a) Air pressure - pumps - The Barometer Torricelli - Guericke.

Weather reports and maps - cyclones and anticyclones.

(b) Convection Currents in air - Ventilation - winds - Trade winds, monsoons, land and sea breezes.

(c) Evaporation and Condensation. Causes of rain.

(d) Conduction of heat - Miners' Lamps - Davy.

(e) Composition of the atmosphere. Burning - mixtures and compounds - Composition of the air - Oxygen and Nitrogen. Properties and preparation of oxygen. Rusting - Priestley and Lavoisier.

Carbon dioxide - fire extinguishers. Presence of carbon dioxide in the atmosphere - presence in rocks and chalk.

TERM III.

Plant Life.

(a) Seeds - germination - leaf - breathing and storage organs.

(b) Feeding system and nutrition. Soil - raw materials for plant food.

(c) Nitrogen - bacteria and nitrogen, artificial fertilization.

General Revision.

SECOND YEAR.

TERM I.

(a) Sun as a source of heat and light.

(b) Solar system.

(c) Pull of the earth - extension of springs - spring balance.

(d) Lever, physical and household balance.

(e) Pressure - pressure in liquids. Buoyancy - Plimsoll line - submarines.

(f) Sun as a source of light - shadows - eclipse of the sun.

(g) Reflection and applications.

(h) Bending of light - lenses - Eye, Camera - Spectrum and colour.

(i) Burning in air - elementary study of acids and alkalies - Carbon dioxide - hard and soft water.

(j) Action of acids - hydrogen. Preparation and use of hydrogen.

TERM II.

(a) Magnets and magnetism of earth - the mariners' compass.

(b) Electric current cells and high tension batteries - accumulators.

(c) Electromagnets - electric bells.

(d) Bell in a vacuum - Transmission of sound.

(e) Heating effect of an electric current - lamps.

(f) Chemical effect of an electric current - electro plating.

(g) Electric motors.

Ampère and Faraday.

TERM III.

(a) Food and fuel.

(b) Circulation, Respiration, breathing as a form of combustion.

(c) Digestion system in animals.

(d) Animal kingdom - man.

(e) Elementary human physiology.

Revision.

Pasteur, Huxley, Fabre.

After the first two years particular branches of science are studied in more detail, and a bias is introduced into the work.

PART II.

A Physics Syllabus for the Academic group.

THIRD YEAR

TERM I.

(a) Action of a force - motion - velocity and acceleration.

(b) Acceleration due to gravity.

(c) Two forces - resultant and equilibrium, parallelogram and triangle of forces.

(d) Inclined plane.

(e) Friction.

(f) Work power and energy.

(g) Moments and centre of gravity.

(h) Machines - wheel and axle pulleys and screw jack.

(i) Fluid pressure - Pascal's Law - Hydraulics.

(j) Capillarity and surface tension.

TERM II.

(a) Sources of heat.

(b) Expansion of metals - applications coefficients of expansion.

(c) Expansion of liquids - thermometers.

(d) Gas Laws - convection.

(e) Quantity of heat - specific heat.

(f) Change of state melting and boiling - latent heat.

(g) Water vapour in the atmosphere.

(h) Mechanical equivalent of heat.

(i) Radiation.

TERM III.

(a) Heat and light - propagation of light.

(b) Intensity - photometry.

(c) Reflection (i) plane mirrors - rotation of reflected beam - sextant.

(ii) Curved mirrors.

(d) Refraction - Laws - indices.

(e) Lenses - optical instruments.

(f) Colour.

FOURTH
~~SECOND~~ YEAR.

TERM I.

(a) Magnets - magnetic induction. magnetic force - magnetic fields - Terrestrial magnetism - declination and dip.

(b) Electrostatics - Elementary phenomena - attraction and repulsion. potential - charging by induction - capacity - condensers.

TERM II.

(a) Electric Current - cells - accumulators - electro magnets - bells and indicators boards, telephone.

(b) Magnetic field due to a current - the ampere and volt.

(c) Ohm's Law - resistance - resistance in series and parallel - Lamps.

(d) Ammeters and voltmeters.

TERM III.

(a) Heating Effect of a current - Joule's equivalent - Applications.

(b) Chemical Effect of a current - Faraday's Laws.

(c) Electromagnetic induction - ~~Creagh's~~ Lenz's Law - induction coil - dynamo.

(d) Introduction to wireless telegraphy, Ohm, Volta, Lord Kelvin.

FIFTH
~~THIRD~~ YEAR.

TERM I.

(a) Revision and fuller treatment of expansion of solids, liquids and gases.

(b) Specific heat and latent heat.

(c) Saturated and unsaturated vapours - vapour density.

(d) Conductivity.

(e) Heat and work - steam engine.

(f) Radiation - visible spectrum.

(g) Revision and more detailed treatment of photometry and reflection.

(h) Refraction - indices and critical angle.

(g) Lenses and optical instruments.

(h) Spectrum - spectrometer. colour - rainbow.

TERM II.

(a) Production, transmission and reflection of sound.

(b) Velocity of sound in air.

(c) Pitch - tuning fork - amplitude, quality.

(d) Monochord and resonance in air columns.

TERM III.

(a) Revision in more detail of magnetic fields - unit pole inverse square law.

(b) Terrestrial magnetism - measurement of H.

(c) More detailed study of electrodynamics.

Throughout the course the fundamental bases of physics e.g. the laws of gravity, the conservation of energy and mass, are continually stressed.

PART III.

PHYSICS SYLLABUS FOR AN INDUSTRIAL GROUP.

THIRD ~~FIRST~~ YEAR.

TERM I.

(a) Force - tension and compression - stretching of materials - stress and strain. Hooke's Law - elastic limits - factor of safety.

(b) Two forces - resultant and equilibrium - parallelogram of forces - triangle of forces - vector diagrams.

(c) Moments of forces - Lever and centre of gravity.

(d) Parallel forces and couples.

TERM II.

(a) Action of forces producing motion - velocity and acceleration. Force and acceleration - Work and power.

(b) Resolution of forces - inclined plane.

(c) Friction - sliding and rolling friction - lubrication.

(d) Simple machines - efficiency and mechanical advantage.

TERM III.

(a) ~~Heat~~ THE STEAM engine - functions of principal parts.

(b) Effects of heat - expansion of solids and liquids.

(c) Gas Laws.

(d) Melting and boiling - condensation.

(e) Convection currents in liquids and gases.

(f) Conduction of heat.

(g) Conduction and radiation from boilers.

(h) Heat and work.

FOURTH
~~SECOND~~ YEAR.

TERM I.

(a) Forces on beams and columns. Shear and torsion.

(b) Moments and couples.

(c) Friction in more detail. Coefficient of friction - sliding, static, and rolling friction.

TERM II.

(a) Machines - transmission of power by belts - Brake Horse Power.

(b) Pressure in liquids - Pascal's Law - hydraulics.

(c) Motion in a circle - governors and flywheels.

TERM III.

(a) Heat engines.

(b) Calorie and British Thermal Unit - calorific power of fuels - specific heat.

(c) Properties of steam - latent heat, saturated and superheated steam.

(d) Gas Laws - indicator diagrams.

FIFTH ~~THIRD~~ YEAR.

TERM I.

(a) Magnets and magnetic fields.

(b) Electric current - cells - accumulators.

(c) Heating and Chemical effect of an electric current - ampere and volt.

(d) Ohm's Law - resistance. Lamps - kilowatt and electric power.

TERM II.

(a) Ammeters and voltmeters.

(b) Joule's Equivalent.

(c) Electromagnetic induction, electric motors and dynamos.

TERM III.

(a) Internal combustion engine. Explosive mixtures and flask points, tests on oils.

(b) Magnetos and induction ~~and~~ coils.

General Revision.

Although the general design of school laboratories is usually the work of the school architect it is well that the science teacher should have definite suggestions to put forward. The size and equipment of laboratories are partly a matter of regulation and partly depend on the generosity of the School authority. Practical experience of work in school laboratories has shown some points which might receive attention. The walls of the laboratory should have a brick rather than a plaster surface, for it is frequently necessary to fix up wall apparatus. Along one side of the room, a wall bench fitted with a sink and electrical connections, and along another side courses of hard wood six feet and three feet from the ground will be found very useful. Four or six benches about 4 feet x 8 feet are convenient and, if no lecture theatre is available, the two front benches should be moveable. The benches should be fitted with drawers and be of the open rather than the counter type. An adequate supply of cupboards and open shelves is a necessity, and it is important that the cupboards should not be too deep. The windows should be fitted with blinds and a smaller dark room for light and electrical experiments is an advantage. If the school workshop is not conveniently placed a small work bench should be supplied with a small power driven drill, a vice, soldering and brazing equipment and if possible a lathe. The school electrical supply is generally alternating current, and direct current, 30-50 volts, 30-15 amps, should be obtainable preferably by means of a rotary converter induction motor and direct current dynamo. [redacted].

TABLE 16 A GENERAL SCHEME FOR A SENIOR SCHOOL.

TIME.		SUBJECTS
9.–9.30 A.M.	MORNING SCHOOL.	ACADEMIC STUDIES. English, History, Geography, Mathematics etc.
9.30–10.50 A.M.		
11–12.20 p.m.		
1.45–3.35 p.m.	AFTERNOON SCHOOL	PRACTICAL STUDIES. 1 afternoon Handicraft; 2 afternoons Science; 1 afternoon Games and Educational Visits alternately. In the last period of each afternoon the pupils follow their own desires.
3.45–4.45 p.m.		

Both the quantity and the quality of physical apparatus is determined by financial considerations. Throughout the work, commercial apparatus can be used with advantage and in mechanics more especially real machines should always be obtained. In this respect, ~~particularly~~, the school materially benefits by a close co-operation with the industries and the works of the district.

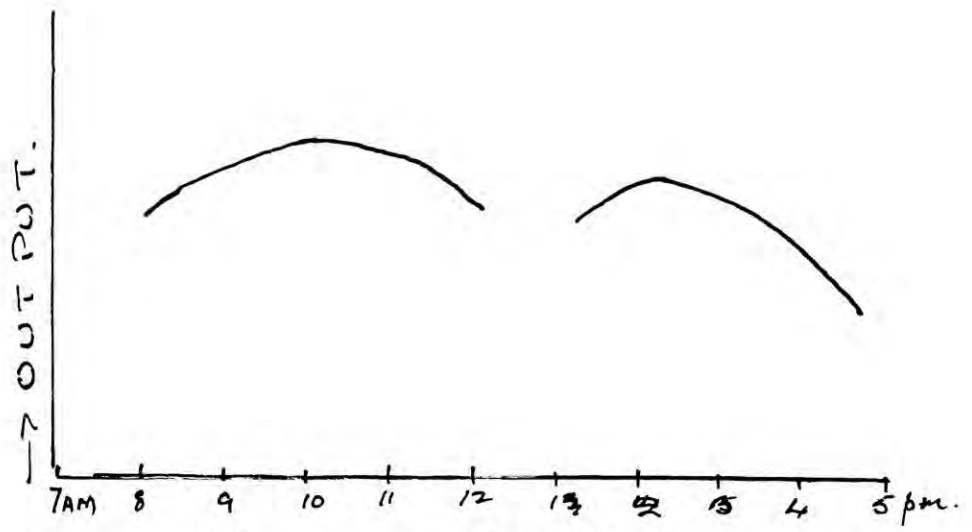
The Senior School is a new conception, and before conditions become too stereotyped, it is well to consider what general changes might be made with advantage. In the first place it is generally recognised that the attitude of both the children and the parent has been considerably modified in recent years. One feels, therefore, that bearing in mind the Gary Experiments, that more use might be made of the schools. On the other hand in modern times there has been a growing tendency to supplement school instruction by compulsory home work. School and school work are important factors in the education of the child, but the home influence has also a definite place and one wonders how far compulsory homework can be justified.

"Home life and influence are so vital to the education of the young", says Sleight, "that nothing should be done by the school which might force the child to isolate himself from the family for a greater part of each evening as is so often the case"[1].

It is suggested, therefore, that, following the precedent of the Junior Technical Schools, the school day of the Senior School should be from 9 a.m. to 12.30 p.m. and

1. The Organisation of Curricula of Schools — Sleight.

A TYPICAL FATIGUE CURVE



From 11th Annual Report of
Industrial Health Research Board
P. 22.

from 1.45 p.m. to 4.45 p.m. and that compulsory as opposed to voluntary homework should have no place.

The curriculum of the Senior School is at present the subject of much research. It is realised that in the past there has been too much division into separate subjects and the tendency is to make the curriculum less rigid. Practical subjects involve less strain on the mentality of the child and need longer periods for effective work. In framing the curriculum for schools it has long been tacitly accepted that the practical lessons should as far as possible be restricted to the afternoon periods, for the mental efficiency of the child decreases during the day. It is suggested, therefore, that in the Senior School the academic subjects, English, History, geography, etc. should be taught in the morning, and afternoon school should be devoted to practical work, handicraft, science, art, singing, etc. While this might be difficult for the whole school, it should at least be a feature of the last two years of the course, and, by such a scheme, provision could be made for Day Continuation Classes on the lines already suggested. The general scheme for such a school is shown in Table 16. The last hour each day is a new feature. In this period the child should be left to follow his own inclinations, but the freedom should be freedom of choice rather than freedom from restriction. The time might be devoted to work in the laboratories, the workshops and libraries, or to school plays and societies; a French lesson might be given in the period rather than in the general curriculum. Provision is also made for a school visit once a fortnight, for in modern education these visits should be an important feature of the school work.

In the scheme the time devoted to science has been extended to four hours a week, for, in pursuance of the policy of the Hadow Report, the whole curriculum must have a more practical outlook, and, as science is to be taught in close relationship with handicraft, more time for this subject is inevitable.

The science work in these schools will follow the general lines which have been established. The type of work, while similar in general scope, will be less ambitious and differ in treatment, the interaction with handicraft being a marked feature.

SCIENCE SYLLABUS.

Part I. 11+ to 13+ .

This part of the scheme should follow the general lines suggested for the secondary school group but the syllabus will be taken in less detail. It will be seen that the scheme conforms to the suggestions of the Hadow Report. "The courses in elementary science in Modern Schools and Senior Classes might be grouped round a simple syllabus consisting of:-

(i) The chemical and physical properties of air, water and some of the commoner elements and their compounds, the elements of meteorology and astronomy based on simple observation and the extraction of metals from their ores.

(ii) A carefully graduated course of instruction in elementary physics and simple mechanics, abundantly illustrated by means of easy experiments in light, heat, sound and the various methods for the production and application of electricity.

(iii) A broad outline of the fundamental principles of biology, describing the properties of living matter,

including food, the processes of reproduction and respiration, methods of assimilation in plants, the action of bacterial organisms and the like.

(iv) Instruction in elementary physiology and hygiene based on lessons in biology."[1]

PART II.

At 13+ a definite bias will be introduced into the curriculum and although the syllabus in science must at present be mainly a one year course, the scheme must be capable of extension for those children who continue at school beyond the school leaving age and for those children who, as re-organisation proceeds along the suggested lines, continue to attend a part time course in Day Continuation Classes.

As re-organisation becomes effective, children in the Senior Schools who, in the first two years of the course, have shown an interest in academic studies, will be transferred at 13+ . The bias of the children in ~~these~~ SENIOR schools after 13+ will therefore be either industrial or commercial. Again with the humane aspect of science clearly in view, a more detailed study of elementary physics will be commenced with the industrial group while biology will be favoured for the commercial bias. As the Hadow Report suggests:-

"Science courses for boys and girls who have been unable to keep pace with the more forward children and have been placed in separate classes in non-selective Modern Schools and within Senior classes might be largely confined to elementary physics with abundant illustrations showing

1. The Education of the Adolescent. P.222.

the practical applications of the simple principles involved. It would seem on the whole inadvisable to teach more than the bare elements of chemistry to such children as they would not probably, as a rule, have much aptitude for abstract thought. We think, however, that with the general science as a basis the science teaching for such children should include a considerable element of biology which should be linked up with instruction in elementary physiology and hygiene."[1]

The organisation of suitable science courses in these schools is complicated by the meagreness of the equipment. Yet to banish science from the curriculum until adequate equipment and properly trained teachers are more abundant, is not in the best interests of future progress. Some start must be made. In the main, the general remarks on laboratories in secondary schools are applicable to Senior School laboratories. The laboratories in the Senior Schools will be more simple in type. In general, separate physics laboratories will be exceptional, one laboratory serving for all science. The space per child must be approximately the same as that for Secondary Schools, i.e. 30 square feet per pupil. Thus a modern Senior School classroom, 25 ft. by 20 ft. will bepresent the minimum size for 20 pupils. The apparatus will in the initial stages be mainly raw material, and again, much is possible if the interest of parents and employers are aroused.

The curriculum of the Practical group is as yet a matter of speculation, but it is clear that manual work must

1. The Education of the Adolescent. P.225.

be one of the main features of the course. With the less backward children some science of an observational character might be attempted and an interest in nature and personal hygiene cultivated. With the more retarded children little science instruction is possible, ~~for~~ ambition must not outrun ability to perform.

For in education, efficiency is determined not only by the highness of the aim, but by the measure of the attainment.

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