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6. SCIENCE CURRICULUM CHANGE IN VICTORIAN ENGLAND: A CASE STUDY OF THE SCIENCE OF COMMON THINGS

Derek Hodson

David Layton has postulated an evolutionary model for curriculum development in which school subjects pass through three distinct phases: an initial phase propelled by the missionary zeal of untrained, enthusiastic pioneer teachers and by pupils who see immediate relevance in their studies; a development phase of growing academic respectability during which students and teachers are attracted by the subject's increasing intellectual stature and status; and a mature phase of formal scholarship, in which developments are determined by the internal logic of the subject and the judgements of its practitioners, rather than by relationships with the world outside or the needs and aspirations of the pupils (Layton, 1972a). If Layton is correct, then as a well established subject in the secondary school curriculum, science should exhibit the characteristics of a mature branch of scholarship. Amongst these characteristics are domination by examinations, remoteness from industry, commerce and the everyday concerns of pupils, and a tendency to promote in pupils an attitude of resignation and disenchantment through excessive emphasis on abstraction. Even the most generous of critics of science education in the U.K. would admit the truth of some of these charges. Such abstraction, remoteness from real life and formality of teaching methods may be inevitable consequences of the drive towards academic respectability, status and influence on the part of subject teachers. As Goodson (1983a) remarks, 'high status in the secondary school curriculum is reserved for abstract theoretical knowledge divorced from the working world of industry and the everyday world of the learner'. In a

country that depends for its economic well-being on manufacturing industry, remoteness from industry is a particularly serious charge against science education and has been blamed by some for Britain's poor economic performance in recent decades: 'the general ethos and thrust of British education are, if anything, hostile to industry ... as a result too small a proportion of the national talent seeks a life in industry' (Barnett, 1979). So marked is this hostility, abstractness and remoteness that Layton is moved to declare that the secondary school science curriculum provides 'an inadequate basis for the education of all but future professional scholars' (Layton, 1972a).

Whilst there have, of course, been a number of attempts to introduce a more technology-oriented science curriculum, with the laudable goal of producing a more technologically literate citizenry, these attempts have generally failed (McCulloch, Jenkins and Layton, 1985) because of the pressures brought to bear by subject groups with a vested interest in maintaining the academic status quo. As a consequence, there must be real concern about the capacity of the secondary school curriculum to accommodate the most recent attempts at reorientation occasioned by the information technology and micro-computer revolution. Attempts to introduce courses with a social, industrial or technological bias have often been summarily dismissed or tolerated only as lower status courses for the less able. Millar (1981a) contrasts this very sharply with the situation in West Germany, where such attempts have been much more successful. In the U.K., however, the secondary curriculum continues to be dominated by the formal, abstract aspects of the subject and 'high status (and rewards) ... associated with areas of the curriculum that are (1) formally assessed, (2) taught to the "ablest" children, (3) taught in homogeneous ability groups' (Young, 1971). When attempts have been made to challenge the accepted view of school science, the result has often been fragmentation into two very different kinds of science curriculum: academic science and non-academic science - 'the former claiming credibility from the professional scientific community, and the latter through notions of "relevance" and immediate interest for the pupils' (Young, 1976). As a consequence of these differences in status and justification, 'relevance' and intellectual credibility have come to be regarded

as incompatible and courses for the most able pupils (by definition, those deemed capable of passing O-level and A-level examinations in academic subjects) have become increasingly abstract and examination oriented, whilst those for the less able have been oriented towards industry and the environment. Two major consequences have usually followed: firstly, neither group of children has received a satisfactory or complete science education and, secondly, assumptions made about the scientific abilities of children at the point of selection have been reinforced by the provision of significantly different courses, with the inevitable consequence of marked differences in terminal knowledge, skills and attitudes.

Brock (1975) has identified 1839, the year of Liebig's arrival at the University of Giessen, as the 'symbolic starting point for the development of modern science education'. The ideal of the research school he founded there, which later was to attract large numbers of young British scientists, was research and inquiry for its own sake. This provided a concept of 'pure laboratory science' which was to dominate school science curricula, especially for the more able children, throughout modern times - indeed, up to and beyond the Nuffield and Schools Council courses of the 1960s and 1970s. But its emergence as the dominant conception of school science did not go unchallenged. In the mid-nineteenth century at least one other conception of what is appropriate school science was actively promoted: the Science of Common Things. That pure laboratory science eventually triumphed over the Science of Common Things and became established as the 'correct' view is not disputed. Why it became established is a rather more interesting question. It will be argued that the choice of a particular model for school science reflects the distribution of power in society and the interests and views of those in power. The science curriculum, like all aspects of education, is subject to patterns of control by dominant interest groups. As the authority and influence of these groups shift, so the nature of the curriculum changes. In the words of Bernstein (1971), 'How a society selects, classifies, distributes, transmits and evaluates the educational knowledge it considers to be public, relects both the distribution of power and the principles of social control'.

The Rise and Fall of the Science of Common Things.

> The earliest attempt to include science in the curriculum of elementary schools seems to have taken place at a school in Cheam founded by Charles and Elizabeth Mayo, whose 'Object Lessons' were designed to promote 'habits of accurate observation, correct description and right judgement upon the things of nature and art' (Mayo and Mayo, 1849). Textbooks written as aids to infant teachers wishing to adopt object lessons, including Lessons on Objects (1831) and Lessons on Shells (1832), proved highly successful and object lessons quickly became established as the basis of science education in the early years of a child's elementary schooling. It is noteworthy that the principal aim of this science education was not scientific understanding, but 'religious understanding and moral improvement'.
>
> ... and when the intelligence is awake and stirring, the teacher should gradually lead them to the moral lesson or holy doctrine connected in scripture with the object he has shown them.
>
> (Mayo and Mayo, 1849)

The significance of this motivation should become apparent later. It is interesting, too, that the major emphasis was on direct experience of objects, in order to 'cultivate the faculty of observation, this being the first faculty developed in the infant mind'. Similar work was in progress at the Edinburgh Sessional School for the Urban Poor, where John Wood promoted the study of objects as an alternative to the more traditional pedagogy based on words, symbols and abstractions.

> Never should there be too long and too scrutinizing an investigation into the mysteries of great discoveries and high science ... but rather agreeable descriptions and examinations of objects within the reach of their senses and understanding.
>
> (Wood, 1831)

In the 1840s a small but influential group of clerics, clearly influenced by the work of Mayo and Wood, promoted the teaching of science as fundamental to the moral and religious salvation of the labouring classes. Notable among these was the Rev. Richard Dawes, who became Rector of Kings Somborne, Hampshire in 1837 and, with the help of a government grant, opened a National Society school there in 1842.(1) Dawes' school quickly established a reputation for outstanding educational attainment. Two significant curriculum innovations lay behind his success: the use of reading books with a scientific rather than a religious content, and a radical approach to the teaching of science. This scheme, which soon became known as the Science of Common Things, began with a consideration of the 'everyday concerns of common life', such as clothing and its manufacture, consumer articles of various kinds, and the 'products of the parish'. The course then proceeded to explanations 'of a philosophical kind', concerning the action of pumps, the expansion and contraction of materials, and the nature of electricity, heat, light and sound.(2) Such was the success of this new curriculum that within two years of opening his school, Dawes had to plan, furnish and equip an extra laboratory in order to meet increasing demand for scientific education (Layton, 1973). Dawes' work received official recognition and lavish praise in a report by H.M. Inspectorate in 1845. Three years later, the minutes of the Committee of Council on Education (1847-8) contained a long, detailed and enthusiastic account of Dawes' curriculum organization by HMI Rev. Henry Moseley, who subsequently undertook a vigorous promotion of the Science of Common Things.

Layton (1973) identifies three conditions necessary for the establishment of science in the elementary school curriculum: well-designed and inexpensive apparatus and books, suitably trained teachers and a sound and supportive administrative framework. In 1851, a government grant scheme for the purchase of school apparatus was established, with an accompanying authorization for Moseley to prepare a schedule of science apparatus suitable for use in schools and training colleges. Standard sets of apparatus for teaching the Science of Common Things were produced by Griffin of Baker Street, well-known scientific instrument manufacturers. Two thirds of the purchase cost of these

sets was recoverable in grants. Grants for the purchase of school books had been introduced in 1847 by James Kay-Shuttleworth, by then Secretary to the Committee of Council on Education, but most books available to schools were of little use for teaching the Science of Common Things. To remedy the situation Kay-Suttleworth attempted, with mixed success, to commission the writing of suitable books, which would then be included in the list of works eligible for grant. The second major resource necessary to consolidate the position of science in the elementary school curriculum was a supply of well-trained teachers. This was recognized by the Committee of Council, who gave Moseley instructions to draw up a suitable scheme for the training colleges. Moseley seized this opportunity to make science compulsory. Clearly, the kind of science he had in mind was that taught so successfully by Richard Dawes.

The third essential resource for the establishment of science in the curriculum was a sound administrative framework. Much essential groundwork had already been done by Moseley in the early 1850s, through his work for the Committee of Council. Evidence of further official support lay behind the appointment, in 1853, of Lyon Playfair (who supported the view that science should be introduced into elementary education) as Head of Science of the newly formed Department of Science and Art. With these three essential conditions necessary for the development of Dawes' scheme reasonably satisfied, and those schools already using the scheme reporting considerable success, the movement seemed poised for rapid growth.

Suddenly, in mid-decade, when all seemed set for the continued expansion of the Science of Common Things movement, several crucial changes occurred. Dawes was moved to the Deanery of Hereford and even though he retained his interest in education, most of his time had to be devoted to his new duties. At about the same time, Moseley was appointed Canon of Bristol Cathedral. He was replaced as Inspector with special responsibility for the training colleges by the Rev. Frederick Temple, who within two years had revised the scheme previously implemented by Moseley, reducing the status of physical science from a compulsory to an optional subject. By 1859 the supply of trained science teachers - the most vital condition of all for the continued success of the Science of Common

Things movement - had been virtually halted. Additionally, a significant change of priority was apparent in official thinking and Playfair, a strong supporter of the Dawes scheme in the early years of the decade, had shifted his ground regarding science in the elementary school curriculum. By 1859, with much reduced grants for science teaching, the role of science in the elementary school curriculum had been severely curtailed and with the Revised Code of 1862 all financial assistance for science was withdrawn. The result of these new regulations was that science disappeared entirely from the elementary school curriculum and it was not until 1882 that it reappeared, this time in the form of 'pure laboratory science' - a view which has persisted, despite the periodic attempts to render it more socially and technologically aware, until the present day. The question of particular interest here is why this change should have come about.

Reasons could be sought in terms of a significant shift in general educational philosophy. As Eggleston (1977) comments,

> 'A new and important feature of the time ... was the redefinition of high-status knowledge as that which was not immediately useful in vocation or occupation.'

Thus,

> 'Advocates of scientific education took care to distinguish it from technical instruction, and to emphasize its liberal and academic value rather than its industrial and commercial utility.'
> (McCulloch, Jenkins and Layton, 1985)

Given such a change of emphasis, the Science of Common Things was a likely 'casualty' in the battle for resources. Byrne (1974) observes that, in all areas of the curriculum, teachers are able to argue much more successfully for the provision of resources for high ability children and for academic courses. Consequently, school subjects have tended to follow a common development pattern, with initial utilitarian or pedagogic considerations yielding to academic considerations (Goodson, 1981, 1983a). Layton, too, seems to hint at inevitability when he argues that pure laboratory

science emerged in preference to alternative approaches because the alternatives had become 'casualties in a process of natural selection as the educational environment had become progessively more sharply defined' (Layton, 1976). It would however, be a serious misrepresentation of the work of these authors to imply that they regard the processes of curriculum change as being propelled solely by 'subject factors'. Curriculum change occurs in response to decisions made by individuals and interest groups; Goodson (1981, 1983a) refers, in particular, to the activities of sub-groups of subject specialists. In explaining the evolution of the science curriculum, 'more sharply defined' is to be interpreted as 'defined by the outcomes of political interactions' (Layton, 1985). Thus, it would be more correct to describe the process of change as political selection rather than natural selection. Reasons for the change of curriculum emphasis must be sought in the interests and motives of the decision makers.

Goodson (1983b) has issued a strong warning against 'raiding curriculum history' for evidence to support theories of contemporary curriculum change. He argues that because such evidence deals with a period before the emergence of the subject groups and professional organizations which he sees as the dominant forces in contemporary curriculum change, generalizations from the nineteenth century to the present day are, at best, oversimplified and, at worst, wilfully misleading. Nonetheless, the rise and spectacular fall of the Science of Common Things graphically illustrates the Layton and Goodson views of curriculum change and the inevitable triumph of the academic over the utilitarian and pedagogic approaches and there may be some evidence that the emergence of 'pure laboratory science' as the most favoured and politically acceptable view of school science was a consequence, in part, of emerging professionalization. Certainly, it was vigorously promoted by the scientific community and by those prominent in the educational establishment, though it will be argued later that the primary motives were socio-political rather than academic.

It has been argued that far from failing, which would be a more usual reason for an abrupt change in curriculum orientation, the experiment with the Science of Common Things was showing signs of marked success (Prophet, 1980). As mentioned

earlier, there was considerable official encouragement for the scheme: grants for the purchase of books and equipment, compulsory science in the training colleges and vigorous support by prominent men such as James Kay-Shuttleworth, Henry Moseley and Lyon Playfair. Evidence of grass-roots support can be found in the enthusiastic reception afforded to a lengthy session dealing with the Science of Common Things at the first annual meeting of the United Association of Schoolmasters, in 1854, in the efforts of the Mechanics' Institutes to disseminate this style of science education to the working classes (Layton, 1973) and in the many articles devoted to the discussion and further development of the Science of Common Things in influential journals such as the Educational Expositor. Typical of these articles was Thomas Crampton's (1855) eloquent support of the Dawes scheme, which concludes -

> Say not that such teaching is unpoetical and utilitarian; it directly tends to develop that true poetry which dignifies the obscure, raises the lowly, exalts the common place.

It would, therefore, be more correct to say that the teaching of the Science of Common Things in elementary schools was abandoned, rather than superseded, and that its abandonment represents a deliberate act of social control. In studying these events the motives and interests of the decision makers must be taken into account. For example, whose interests were being threatened by the success of the Science of Common Things movement and why was pure laboratory science regarded as more acceptable? It is also pertinent to enquire into the motives of those who had promoted the Science of Common Things, in particular the motives of Richard Dawes. Layton (1973) portrays him as a liberal, progressive, educational reformer, but does not ask why this wealthy, middle class cleric should have concerned himself with educating the poor of his parish. In giving an account of Dawes' early life Layton admits there was no hint of his 'passionate concern for the education of the labouring classes' which was to dominate his later life, or of his later 'powerful advocacy of science as an instrument of secular instruction', and he says, 'it is not possible to

do more than speculate' on the changes which occurred in Dawes during his early years at Kings Somborne. By attempting such speculation, it may be possible to gain an insight into Dawes' motivation in developing the Science of Common Things.

Social Control Through Education

In identifying the textbook, individual teachers and the subject committee (and, in particular, the examination sub-committee) as the major sources of 'authority' about science, scientific knowledge and science teaching in the U.S.A., the U.K. and Australia (respectively) during the 1960s and 1970s, Fensham (1980) shows how different social conditions produce different notions of what is legitimate and appropriate school science. It follows that in studying events in the history of science education it is necessary to take account of the social structure and conditions in which the events took place. Otherwise there is no way of accounting for the events and no way of explaining why individuals perceived the situation as they did or acted as they did. In attempting to interpret and explain such events, it can be a major error to eliminate what seems superfluous and irrelevant in order to concentrate on matters which are regarded as most significant in contemporary debate. For thereby we reinterpret the past in solely present day terms and may omit from consideration the very socio-cultural factors which determined the events we are studying and wish to explain. In other words, there is no objective, theory-free historical evidence. All events are viewed from a particular theoretical position and the best we can hope to do is to reconstruct the events by placing ourselves in what we regard as the social and intellectual climate pertaining at the time. Educational debate is carried on in a social context and is, therefore, subject to all the usual ideological, political, cultural and ethical influences. It is important that all these aspects are taken into consideration. Whether a curriculum innovation is accepted and institutionalized depends crucially on the cultural context in which the innovation is proposed and evaluated. In attempting to characterize this 'cultural context' as it applies to the episodes surrounding the Science of Common Things movement, it is important to consider the knowledge resources in educational

philosophy and psychology available to the curriculum decision makers. These 'knowledge resources' included the dominant views about the nature and purpose of education, about the nature of science and scientific inquiry and about children and learning. As far as these latter considerations are concerned there was a well developed 'mentality theory', which asserted that two kinds of mental types exist: those of agnostic mentality capable of handling complex, abstract thought, and those of a banausic mentality, capable only of simple, concrete thought (Shapin and Barnes, 1976). This 'mentality theory' was used to legitimate curriculum proposals for the education of different social classes throughout the latter half of the nineteenth century. In addition, it was generally held that a correspondence existed between the social hierarchy and the distribution of mentalities, such that the upper classes were of a gnostic mentality whilst the lower classes were of a banausic mentality. However, all children, whatever their social class, were regarded as being of a banausic mentality. Whilst the education of the upper classes sought to bring about the change to gnostic mentality as quickly and as efficiently as possible, the education of the lower orders sought to fix mentality at the banausic stage. The contrasting aims of education for the two classes are reflected in the contrasting curricular provision - facts and sensory stimulation were seen as appropriate for the lower orders, principles of manipulation and abstractions for the upper classes.

> Also it is for many reasons very important, that discriminations be made in each (subject) between what is most certainly established, and what is conjectural and doubtful, presenting to ... the lower orders ... as much as possible the first and not the second.
>
> (Wilson, 1830)

> We must not make the mistake of ... overlaying the mind of the young aspirant to a liberal profession with facts ascertained and the results arrived at by learned and scientific research, while he is left unacquainted with the steps and processes of the proof.... He should not be tempted to take all upon trust, on the

> ipse dixit of a lecturer, but should be put through such a course of mental gymnastics, as might enable him to climb the tree and gather the ripe fruit for himself.
>
> (Pillans, 1856)

The theory connecting mentality, knowledge and social hierarchy was not founded on any concrete, empirical evidence; it evolved as a rationalization and legitimation of the existing social order. But, once established, it was used as a resource and advocates of significantly different educational policies used it to advance their own case and to denounce opponents. Whilst, of course, a variety of viewpoints existed, a crude dichotomy will be employed here between those views which collectively advocated that the working class be given access to knowledge (the 'liberal viewpoint'), and those which opposed such a move (the 'conservative viewpoint'). The supporters of the 'conservative view' were, in general, the aristocracy and the landed gentry. Indeed, one of the most prolific writers in support of this position was the self styled 'Country Gentleman'. He described society as a pyramid built on a hierarchy of authority: the working people who constitute the base of the pyramid being required to support the superstructure of their social superiors. This hierarchy corresponded to a divinely ordained and unalterable distribution of authority, knowledge and fixed mentality. To increase the knowledge of the masses would automatically make them wish to rise in society, thus altering the balance and threatening the whole social edifice. Consequently, the best way of maintaining the existing social order was to provide no education for the lower orders. Sir Archibald Alison also expressed concern about the consequences of educating the lower orders.

> Educating the lower orders is the only possible account for the extraordinary demoralization of the lower orders and the extent to which licentiousness and profligacy press, not only against the barriers of government, but restraints of religion, precepts of virtue and even the ordinary decorum of society.
>
> (Alison, 1834)

But Alison's stance was different from that of Country Gentleman. He regarded all human beings as having an evil nature capable of misusing any knowledge unless 'restrained by the force of moral precept and sanctified by the simultaneous spread of religious instruction', so that a 'control problem' existed, which could (only) be solved by religious instruction.

> Experience has now proved that the mere education of the lower classes without any care of their religious principles, has had no sensible effect in counteracting the influence of these demoralizing circumstances ... or preventing, by the extension of knowledge ... the growth of human depravity.
>
> (Alison, 1834)

It will be argued later that those in the liberal tradition, who advocated universal elementary education, were attempting to utilize the education system for the furtherance of their own political and social goals. Whichever line of argument individuals supported, whether 'conservative' or 'liberal', one assumption was always made: that the lower orders were only to possess an inferior kind of knowledge. If social stability was to be preserved, the lower orders must be less knowledgeable and have less useful knowledge. If these analyses are correct, Victorian society may be regarded as a triple hierarchy of authority, mentality and knowledge in which education was seen to have a key role. Education was required both to reflect and to maintain this hierarchical structure. Any attempt to interpret science curriculum change in nineteenth century England must assume that the curriculum decision makers acted in accordance with this background of contemporary common sense belief. In considering the motives and intentions of the liberal reformers of education it is tempting, from our present day standpoint, to regard reform and educational provision for the poor as uniformly 'good' and reformers as altruistic individuals motivated by purely philanthropic ideals. However, Richard Johnson (1970) maintains that the Victorian obsession with the education of the poor is best understood as a concern about authority, power and the assertion of control. Johnson argues that those who determined the ele-

mentary school curriculum also determined 'the patterns of thought, sentiment and behaviour of the working class'. In other words, political and social control of the masses could be, and should be established through the school curriculum. Elementary schools were regarded as successful in the eyes of the dominant groups in society if the pupils emerged 'respectful, cheerful, hard-working, loyal, pacific and religious' (Johnson, 1970).

However, not all curriculum proposals reveal their underlying intention quite so clearly. It is in these cases that the refined concept of social control motivation is a useful analytical tool, providing the researcher with a means of penetrating the rhetoric surrounding the proposals. The concept assists the study of curriculum change by focusing attention on both the explicit and implicit motives and interests of the curriculum decision makers. In Richard Johnson's words, it calls into question 'the assumption ... that the development of state educational systems has been an unambiguously progressive process' (Johnson, 1977).

The concept of social control was first employed at the turn of the century by Ross, who argued that social order is established by two categories of social control instruments: ethical (public opinion, personal ideals, arts, etc.) and political (law, education, organized religion, etc.). These latter instruments are 'the means deliberately chosen in order to reach certain ends. They are likely to come under the control of the organized few, and be used, whether for the corporate benefit or for class benefit, as the tools of policy' (Ross, 1929). Some fifty years later Landis modified and extended the concept by arguing that many social control mechanisms operate independently of any conscious attempt to manipulate. In other words, in any situation social control may be operating without the controllers or the controlled recognizing the fact.

> The most deep-seated and important influences in the development of the socialized personality, and in the regulation of human institutions, come from the non-rational, unconscious, all pervasive influences that mold the individual without his knowledge. They are a part of the general culture and become incorporated

> there without any conscious attempt on the part of any particular group, or even of a society to develop or foster them.
>
> (Landis, 1956)

It is, as Donajgrodzki (1977) argues, as though the 'controllers and the controlled are ... trained to their roles' by the socialization process. This refined concept of social control is now a powerful research tool, enabling us to take account of the social structure within which curriculum decisions are taken and to free our interpretations of those events from the self evaluations of the decision makers. Whilst a particular interest group might make deliberate, even cynical use of the curriculum to bring about a degree of social control it is just as likely that the group acts with genuine concern and apparently altruistic motives, unaware of its unconscious social control motivation. Young (1976) has argued that 'those in positions of power will attempt to define what is to be taken as knowledge, how accessible to different groups any knowledge is, and what are the accepted relationships between different knowledge areas and between those who have access to them and make them available'. If this element of socially constructed knowledge is added to the desire to effect some measure of behavioural change, then we have a refined concept of the social control process which suggests that particular interest groups (usually those in positions of power) select particular kinds of knowledge for presentation to particular groups of children, by particular methods, and that they base their curriculum decisions on what is in their interests, rather than what is in the children's interests - though, if Donajgrodzki and Landis are correct, they may do so unconsciously.

James Kay-Shuttleworth is typical of those prominent members of the Victorian middle classes who saw educational reform as a means of exerting social control and, thereby, stabilizing society. In his Manchester pamphlet, published in 1832, he presents a first hand picture of the reality of city life for the lower orders: a vivid picture of domestic squalor, collapse of family life, crime, prostitution, drunkenness, and a high incidence of diseases such as cholera and typhus. Promiscuity and debauchery, which supposedly abounded, were seen as threats to the stability of family life,

resulting in poverty and child neglect; the decline in church attendance was seen as further evidence of the absence of 'suitable' moral values; drunkenness was regarded as a serious problem and public houses were seen as working class meeting places for obscene chatter, gossip-mongering and the fostering of dangerously seditious politics. Raised in such an atmosphere of intemperance, parental self indulgence and child neglect, working class children were seen to begin life predisposed to criminality, unprepared for honest hard work and potentially hostile to capitalism. Similar views were expressed very strongly by Andrew Ure.

> ... from the evil bent of human nature, the slaves of prejudice and vice; they can see objects only on one side, that which a sinister selfishness presents to their view; they are readily moved to outrage by crafty demagogues, and they are apt to regard their best benefactor, the enterprising and frugal capitalist who employs them, with a jealous and hostile eye.
>
> (Ure, 1835)

This instability in working class life was seen to pose a threat to the stable, routine behaviour required by increasing industrialization. If measures were not found to remedy the situation, industrial society and the well being of the middle classes was likely to be at risk. The solution that Kay-Shuttleworth proposed was two-fold: reform of the environment (better sanitation, better housing, a more effective police force, etc.) and educational reform.

> The poor might thus through education be also made to understand their political position in society, and the duties that belong to it, ... (that) they are infinitely more interested in the preservation of public tranquility than any other class of society; that mechanical inventions and discoveries are always supremely advantageous to them.
>
> (Kay-Shuttleworth, 1832)

With his appointment as the first Secretary of the newly formed Committee of Council for Education in 1839, Kay-Shuttleworth's views and rationalizations became official policy and the reports of the Inspectorate during the period of his administration reflect the view that the problems of the working class were largely of their own making and arose mainly through ignorance, laziness or neglect - all of which could be eliminated by personal effort. The solution was seen to lie in altering their system of values, through education: the school should take over the responsibilities of the parent and substitute its own more suitable values for the deficient values of the lower orders. Thus, schools for the lower orders were justified as instruments of socialization. In pursuing this goal he promoted the provision of libraries and Mechanics' Institutes and advocated the view that the school should become the centre for the social and cultural life of the community. The inadequacy of the working class family life had been a frequent target of attack for the liberal reformers at that time, as evidenced by these remarks by James Pillans, a strong advocate of compulsory education, and a major influence on Kay-Shuttleworth's views.

> How important it is, in particular, for the diminution of crime that the infant children of the working classes should be removed from the parental roof during the hours of labour, when it is inconvenient for the mother to tend them, even if her tendence were of any value.
>
> (Pillans, 1829)

Andrew Ure (1835) had argued that the manufacturers themselves should provide infant schools, because 'in such seminaries ... they are sure that the children learn to be obedient and orderly and to restrain their passions; and they are equally sure that, in a large proportion of cases, it is not so in their own homes'.

Another significant influence on Kay-Shuttleworth was the work of Henry Brougham. Brougham himself had been very much influenced by what he regarded as the enlightened approach of the Swiss aristocrat Philipp von Fellenberg, a friend and supporter of Pestalozzi. What was unusual about Fellenberg's approach was his concern for all classes of society: future leaders and led, future employers and employees. His original school for poor children at Hofwyl, near Berne, was expanded to include an intermediate school, for the sons of

farmers, and an upper school, for the socially elite. Fellenberg regarded a practical 'agricultural education', plus a little nature study and drawing, as appropriate for the poor, because of its emphasis on observation and reasoning, and its value in inculcating habits of industry, obedience, frugality and kindliness (Fellenberg, 1839). In addition to the practical work, the curriculum for the intermediate school provided rather more theoretical work and that for the upper school included classics, modern languages, science and music. By establishing this complex of schools, which also included a training college for teachers and a summer school for in-service education of village schoolmasters, Fellenberg created Swiss society in miniature, with all its inherent class divisions. Divisions which he regarded as divinely ordained. By educating different social classes together, each could learn respect for, and understanding of the other and, most importantly of all, the lower orders could see that the lives of those above them were not an endless round of idleness and pleasure, but were subject to strict discipline, though of a different type! In reply to those who were concerned that education of the poor might lead to social revolution, Fellenberg claimed that the peasantry who were educated in the general school were, as a consequence, perfectly content and had no desire to rise above their proper station in society. Brougham saw great possibilities in adapting Fellenberg's ideas to an industrial rather than agricultural context, as a means of stabilizing the social order in England. Although much of Brougham's work was concerned with the education of the adult population of the labouring poor, through Mechanics' Institutes and his Society for the Diffusion of Scientific Knowledge, his message was basically that advocated by Fellenberg: that the better educated the people, the more tranquil and orderly in their political conduct they will be. Kay-Shuttleworth set up a school at Norwood modelled on Fellenberg's experiment at Hofwyl, using teachers recruited from David Stow's Normal Seminary in Glasgow. Stow's influence is apparent in the constant references in the school documents to training, rather than the more usual term of instruction. Training, according to Stow, includes both moral and intellectual development and is a highly skilled craft 'awakening thought, stimulating and directing enquiry and evolving the

energies of the intellect' (Stow, 1836).

There would be no difficulty in seeing a social control motive in a curriculum comprising a moralizing religious education, which featured very prominently in Fellenberg's scheme. What was enterprising about the particular curriculum supported by Kay-Shuttleworth was its emphasis on science. In accordance with 'mentality theory', two conceptions of school science were advanced: one factual and unchanging (for the lower orders), one theoretical and provisional (for the higher orders). The central theme of science for the masses was to be the immutable 'laws of nature'. The world (both physical and moral) was regarded as governed by natural laws instituted by God to serve as guides to human conduct. Those who violated natural behaviour (i.e. those who broke God's laws) would be punished by God, through nature. These punishments were the social evils so vividly described by Kay-Shuttleworth. These ideas found full expression and justification in the phrenology movement, which worked them into a complex system of 'natural laws' incorporating 'mentality theory' and beliefs about the social distribution of mental types. The message comes through very clearly in the writings of George Combe, founder of the British phrenology movement.

> Natural laws do exist, and the Creator punishes if they be not obeyed. The evils of life are these punishments.
>
> (Combe, 1848)

Phrenology and Education

The nineteenth century science of phrenology is often regarded as mere quackery, as a peculiar Victorian enthusiasm that emerged, flourished and died within a few short years and had little significant or lasting influence. It is usually classed alongside phlogiston theory, astrology, transmutation of the elements, ideas such as Wilhelm Reich's theory of orgone energy and the speculative writings of Velikovsky and von Daniken as just another idea 'on the losing side' (MacLaren, 1974). Recently, however, there has been a radical reappraisal of the role of the phrenology movement, such that Cooter (1976) is able to claim that phrenology was 'one of the most important intellectual manifestations of the nineteenth century ...

because of the wide range of Victorian values, ideas and attitudes it appears to have mediated'. In fact, phrenologists were deeply involved in the development of many of the socio-intellectual revolutions of the Victorian era (in anthropology, biology, public health and penal reform, religion, and so on). In attempting to trace the dominant influences on the intellectual life of Victorian society Young (1980) reasserts the view that phrenology played a key role in many of these developments and constituted a major influence on many prominent figures, men such as Chambers, Spencer, Lewes and Wallace. Phrenology was promoted through the Mechanics' Institutes, the phrenological societies (which existed in many major British towns) and the host of phrenological publications, most influential of which were The Phrenological Journal and George Combe's Constitution of Man.

The basis of phrenology was the identification of the faculties of the brain. Whilst phrenologists were somewhat vague regarding the actual number of these faculties, they were clear that individuals were born with a fixed number, in proportions which fixed their characters, personalities and intellectual capabilities. Irrespective of what the particular faculties were, each individual possessed a number of 'animal propensities', 'moral sentiments' and 'intellectual faculties'. Although the animal propensities were not in themselves evil, their abuse and the neglect of the other faculties led to evil. Thus, the ignorant or uncivilized were prone to become ferocious, sensual and superstitious. If, however, individuals had the opportunity to cultivate their moral sentiments and intellectual faculties, they were able to become aware of their own constitution and to control their animal propensities. This new self perception, and with it the awareness of having to live harmoniously with neighbours and fellow workers, would lead directly to happiness. All that was needed to bring about a change in behaviour for the better was the instruction and exercise of the intellectual faculties. Once they were correctly exercised, ignorance would be overcome and development of the moral sentiments would automatically follow. Instruction, training and development of these faculties could be achieved through education, though it was important to recognize that 'the effects of education are always bounded by the natural capacity of the mind'

(Combe, 1852). Whilst modification of and development of the faculties was the prime purpose of education, the basic provision of faculties could not be altered: a 'very large' intellectual faculty could not be developed from a 'very small' one, nor could a 'very large' animal propensity be reduced to one of 'very small' dimensions. Combe clarified official thinking on this matter -

> We cannot essentially change the character of any natural feeling ... and our efforts are limited to restraining the different faculties from improper manifestations, and to directing them to legitimate and beneficial indulgence.... Different capacities are bestowed by Nature on different individuals, and after we shall have done our best to instruct and train the people, there will always remain a sufficient number of them whom no education, however much it may improve their morality, will ever raise intellectually above the humbler duties of civilised life.
>
> (Combe, 1852)

Since individuals were endowed with different faculties of varying strength, people were inherently unequal and could be classified into three mental types. The lowest class was that in which the animal propensities so predominated over moral sentiments and intellectual faculties that, if left to themselves, its members are 'extremely prone to vicious indulgences hurtful to themselves and to society'. The second class comprised individuals in whom the animal propensities and moral sentiments were well balanced. Such individuals were capable of very significant self-improvement through education and personal endeavour. The elite, upper class was made up of those in whom the moral sentiments and intellect were so greatly predominant over animal propensities that 'a perpetual serenity of temper and benignity of disposition reign within' (Combe, 1828). This mental hierarchy laid the foundation for the social hierarchy and since one's mental rank was unchangeable, so was the social structure! The inherent limits to each individual's intellectual faculties ensured that there would be no alteration to the social structure of wealth and power through education.

Rather, an uplifting of the general level of rationality, with concomitant improved morality and social behaviour, was the anticipated outcome. The higher and middle social classes were reassured that their status was not threatened, whilst the lower orders were offered a degree of self improvement, provided they obeyed the Natural Laws which constituted the core of phrenological theory. Those who followed these laws were assured of happiness and success, whilst those who did not would be punished by God through the various social evils referred to earlier. In other words, the social order was seen to be underpinned by the laws of nature, so that instruction in these laws would reinforce the existing social hierarchy. Since the lower orders had only limited mentality, the only possible means of instructing them in the laws of nature was through stimulation of the 'sensory pathways'. Thus, 'mentality theory' and phrenological theory pointed very directly to the kind of science education pioneered by Charles and Elizabeth Mayo, John Wood and Richard Dawes. Even though the Natural Laws were never clearly defined, phrenology quickly became part of common sense knowledge, influencing and shaping the opinions of the increasingly powerful Victorian middle classes. The major treatise on phrenology, George Combe's Constitution of Man (published in 1828), was one of the great Victorian best sellers: within forty years of its publication 100,000 copies had been sold, twice as many as Darwin's The Origin of Species. It is said that even homes which otherwise contained only the Bible and Pilgrim's Progress had a copy of Combe's Constitution of Man. The great success of the book derived from the almost universal appeal of phrenology: it appealed to the upper classes because it reassured them that the social hierarchy was 'natural' and enduring; it appealed to the professional and middle classes because its meritocratic overtones confirmed their attitudes regarding advancement through personal effort and achievement; it appealed to the aspiring members of the working class, who sought from its teachings practical advice on self-improvement.

> Phrenology flourished as a popular science in early Victorian Britain because of a coincidence of three factors: traditional philosophical and theological theories of mind no longer seemed adequate as scientific explanations; rapid changes in the social structure created a sizeable number of reformers who sought an empirical grounding for their social philosophy; and the breakdown of traditional society created for many individuals a wide variety of personal opportunities which were both liberating and perplexing. For three decades phrenology appeared both to a professional, intellectual elite and also to a much wider lower-middle-class and working class audience, to be a successful solution to their scientific, philosophical and practical needs.
>
> (Parsinnen, 1974)

As Young (1973) says, 'it was offered as the key to all philosophical and social problems - a panacea for all social ills'.

In view of this widespread appeal, it would be surprising if phrenological theory had failed to influence the thinking of the liberal reformers in education and been used by them as a theoretical justification in securing their objective of social control of the lower orders. It has been argued by Hodson and Prophet (1983a) that in trying to improve the education of the working class, these reformers had strong socio-political motives and were, in reality, serving their own interests. They conclude that:

i) middle class liberalism was based on an underlying interest in stabilizing and controlling the socially disruptive forces of the lower orders in early industrial society;
ii) phrenology played a crucial role in rationalizing and legitimating these interests;
iii) school science became the vehicle by which this control was to be established.

From this theoretical perspective it is possible to analyse the work of Richard Dawes and the events surrounding the rise and fall of the Science of Common Things.

Richard Dawes and the Science of Common Things

Syllabus details of the Science of Common Things can be found in Layton's (1973) classic work Science for the People. Of more significance here

are the teaching methods Dawes employed, his underlying philosophy, his motivation and his actions.

Realizing how few teachers possessed the knowledge and expertise necessary to implement his proposals, Dawes produced a teacher's guide: Suggestive Hints towards Improved Secular Instruction making it bear upon Practical Life (1854). This book, which might lay claim to be the first curriculum development package in science, contained a powerful argument in favour of teaching science 'bearing upon the arts of life and of everyday things' and an abundance of practical illustrations. This emphasis on direct experience, though not necessarily on individual practical work (as advocated by his great contemporary John Stevens Henslow at Hitcham in Suffolk), was a powerful and significant element in Dawes' scheme and derived directly, as indicated earlier, from 'mentality theory'. 'Mere verbal explanations ... are of no use whatever', he argued, and words and other abstractions only become useful when accompanied by practical illustration. The overriding aim of schoolmasters ought to be 'to make children observant and reflective; to make them think and reason about the objects around them' (Dawes, 1857). By using examples that were familiar to them, and by providing opportunities for the use of reason, Dawes was providing instruction in science which proved spectacularly successful. As will become apparent later, it was this very success that sowed the seeds of the scheme's own destruction.

It was suggested earlier that speculation about Richard Dawes' early life at Kings Somborne might provide an explanation for his concern with the education of the poor and his development of the Science of Common Things. A concern with social control and a commitment to phrenological ideas together constitute such an explanation. Social stability was a predominant concern of the mid-nineteenth century middle classes and in Dawes' case this concern was made more immediate by direct contact with the poor, through his parish work at Kings Somborne, described by Layton (1973) as an 'especially poor parish of some 1,100 people'. Such experiences inevitably lead to conflict: on the one hand, genuine concern for the lot of the labouring poor and, on the other hand, a deep anxiety that their struggle for self-realization, improvement and advancement might destroy the

stability and order of society. Phrenological theory would have provided a ready rationalization of this conflict and a possible solution: self improvement for the masses and stabilization of the social hierarchy via education. The poor would be shown that whilst they might improve their lot considerably, they could not expect to alter their natural place in society. Understanding and acceptance of the laws of nature, and their justification of the existing social hierarchy, was to be achieved through studying the Science of Common Things.

A more concrete link between Dawes and the phrenology movement may be found in his association with William Ellis, a leading figure in the development of secular education and an influential phrenologist. De Giustino (1975) describes how Ellis's schools quickly became established as 'the working models for other phrenologists interested in education'. Because of his vigorous promotion of phrenological principles and his concern to remove religious instruction from the curriculum, Ellis was strongly criticized by the clergy for fostering a 'Godless education'. Given their contrasting backgrounds, social connections and personal reputations, it is rather surprising that Dawes, the clergyman, should agree to edit and to write the preface to a book written anonymously by Ellis, the 'Godless educationist'. It is even more surprising that this work (Lessons on the Phenomena of Industrial Life) should have been promoted by Dawes and Playfair for adoption by the Church Training Schools. Layton does not question the apparent contradiction in this collaboration, nor does he note Ellis's strong phrenological commitment, but he does point to a certain similarity of views.

> Ellis and Dawes were, in fact, old allies who had discovered much common ground in their discussions within the Society of Arts on the subject of schools for the labouring poor.
>
> (Layton, 1973)

Through contact with Ellis, Dawes must have been familiar with phrenological philosophy, and the act of lending his name to a phrenologically-based treatise on the laws of social economy indicates his acceptance of much of this philosophy.

Thus, it would seem that Dawes and his contemporaries in elementary science education were engaged in the articulation and development of an education for the poor designed to fit them for their industrial occupations and to develop in them attitudes of obedience and orderliness. The intention was to teach them that personal shortcomings were responsible for their present unhappy situation and that the opportunity for improvement lay in their own hands. Through individual efforts, learning to rely on one's own hard work, the improvement of diet, ventilation and cleanliness in the home, and through constant practice of habits of prudence, sobriety and self-denial, the general condition of the lower orders would be improved - although their overall station in life would not.

In drawing attention away from the economic and social demands of capitalism as the cause of their current deplorable quality of life, and presenting the idea of self-help through science, the liberal reformers can be seen to be inculcating the values of the newly powerful and industrially dependent middle classes into the labouring poor, thus stabilizing the social structure and furthering their own vested interest. In arguing that the move to establish the Science of Common Things in the elementary schools was an attempt to establish some measure of social control to counteract the problems created by early industrialization, Hodson and Prophet (1983a) identify four key objectives.

1. To gain acceptance by the lower orders of a pre-ordained social hierarchy and their low position in it.
2. To foster the idea that the poor physical and economic state of the lower orders was of their own making and not the fault of the capitalist system.
3. To encourage them to improve their social conditions, but not their social position, by the application of simple scientific principles to their everyday lives.
4. To inculcate a set of moral values which were the dominant values of the new middle class and were seen as essential for the ultimate success of industrialization.

A fifth and closely related objective was the fostering of the orderly behaviour and obedience necessary for the smooth operation of the indus-

trial enterprise. In other words, the production of a compliant force of factory workers.

In the early 1850s this experiment with the science curriculum appeared poised for success, but by the end of the decade it had lost its momentum so completely that the Revised Code of 1862 contained no proposals at all for elementary school science. The reasons for the rapid decline of the Science of Common Things movement lie in the power struggle between the liberal reformers and the conservative establishment. Again, concern with social control is seen to have motivated the curriculum decision-makers.

The Emergence of Pure Science

The declared goals of the Science of Common Things were the general intellectual development of children, the improvement of reading skills, the acquisition of scientific knowledge related to the child's immediate environment, and the provision of experience for the exercise of reason, speculation and imagination. It was assumed, in accord with the views of Charles and Elizabeth Mayo, that once self-confidence and clarity of thought had been achieved, improvement in the moral and religious condition of the children would follow. The emphasis on applied sciences, such as mechanics and agricultural chemistry, ensured that education could be related to that which was familiar to the labouring classes and that this familiarity would ensure that the restricted linguistic experiences of so many elementary school children was no longer an insuperable obstacle. The Science of Common Things was to be the vehicle by which the lower orders were equipped to think for themselves.

> Here was no crumb of upper-class education charitably dispensed to the children of the labouring poor. Instruction was related to a culture which was familiar to them and provided opportunities for the use of reason and speculation by drawing upon observations which pertained to everyday life. Understanding and the exercise of thought were not the prerogative of the upper and middle classes.
>
> (Layton, 1973)

The significance of this last sentence cannot

be overemphasized. As a consequence of the spectacular success of the Science of Common Things in achieving this goal, influential scientists of the day - men such as Owen, Hooker, Lyell and Faraday - advanced the view that the ruling class was in danger of losing its dominant position through lack of scientific knowledge and that the introduction of science into the curriculum for the children of the upper classes was an urgent priority. The science they considered appropriate was 'pure laboratory science', as practiced at Liebig's research laboratory at Giessen University, which in recent years had been attracting large numbers of British students. The ideal of this research school - research and enquiry for its own sake - provided a concept of pure science which was a ready-made candidate for inclusion in the curriculum for the education of the higher orders, with its traditional emphasis on abstraction and social distancing. Robert Hunt (1854), Secretary to the Society of Arts, argued that whilst the practical aspect of science was of 'some importance', it was the study of abstract science that 'refined and elevated human feelings' and was the true mark of a gentleman. Science was to be admitted to the curriculum of the public and grammar schools provided that it conformed to the principles underpinning the traditional classical education. In other words, it should emphasize academic and cultural matters rather than commercial and industrial concerns. This view of science as a rigorous form of mental training gained ready support from the scientific community and from the universities (Barton, 1981).

Under the chairmanship of Lord Wrottesley, the parliamentary committee of the British Association for the Advancement of Science sought the opinion of many eminent scientists about the most appropriate form of science education for the upper classes. The report clearly indicates a strong belief in the educational value of pure laboratory science. It could be argued that the report also implicitly reflected the growing awareness of a serious problem: that science education at the elementary level was proving highly successful, particularly as far as the development of thinking skills was concerned, and that the social hierarchy was under threat because there was no corresponding development for the higher orders. Giving the labouring poor access to a particular form of know-

ledge, and a particular set of skills, whilst denying it to their superiors, was seen as a very dangerous state of affairs. Wrottesley, himself, drew attention to this matter when he commented on the impressive grasp of scientific principles by children in schools for the labouring poor compared with those in grammar and public schools. He described in detail an incident in which he asked a class for the explanation of the principle of a pump.

> ... a poor boy hobbled forth to give a reply; he was lame and humpbacked, and his wan emaciated face told only too clearly the tale of poverty and its consequences ... but he gave forthwith so lucid and intelligent a reply to the question put to him that there arose a feeling of admiration for the child's talents combined with a sense of shame that more information should be found in some of the lowest of our lower classes on matters of general interest than in those far above them in the world by station.
>
> (Wrottesley, 1860)

Wrottesley's conclusion on the incident reflects the fears of the upper classes concerning the possible consequences of such education of the lower orders.

> It would be an unwholesome and vicious state of society in which those who are comparatively unblessed with nature's gifts should be generally superior in intellectual attainments to those above them in station.
>
> (Wrottesley, 1860)

Similar views, showing the depth of the disquiet, were expressed by many other influential individuals. In an article in the Edinburgh Review, A.C. Tait (who followed Arnold at Rugby and later became Archbishop of Canterbury) expressed concern that the education of the poor was making such good progress that the higher orders were being left behind. Consequently, it was 'absolutely necessary for government to attend to the education of the rich' (Tait, 1854). He predicted a complete overturn of the social order if 'the son

of a labourer possesses better knowledge than the son of the squire'. It is interesting to note that he also made direct reference to Dawes at Kings Somborne and to the undesirability of the children of labourers being educated alongside the sons of the higher orders. It would seem that Dawes had acted very directly on Fellenberg's ideas. By the time of the publication of the Report of the Public Schools Commission (1864), this anxiety had reached epidemic, almost hysterical proportions.

> It is not only an unhealthy but also a dangerous state of things in some respects, that the material world should be very much better known by the middle classes of society than by the upper classes.
>
> (H.M. Commissioners, 1864)

If it was considered such a 'dangerous state of things' that the new middle class had access to a form of knowledge denied to the upper class, how much more serious must have seemed the situation described by Wrottesley, in which the lowest social group was seen to be becoming superior in scientific knowledge.

By the late 1850s a campaign, backed by The Times, had been mounted on two levels. On the one hand it advocated the merits of pure science as an essential component of the curriculum for the higher orders and, on the other hand, it advocated a halt to the scientific education of the lower orders, whom it saw as being dangerously over-educated. The higher orders had realized that those below them in the social hierarchy were gaining access to scientific knowledge, and its attendant critical thought processes, and that such a valuable resource might be used in future socially and politically undesirable activity. It has been suggested that this, and not the appearance of what Layton (1973) calls 'better alternatives', was the reason behind the abandonment of the Science of Common Things (Hodson and Prophet, 1983b) and that the Revised Code of 1862, which removed science from the elementary school curriculum, was the institutionalization of these beliefs, justified on administrative and financial grounds. Prominent amongst the advocates of the 'new' elementary school curriculum was Joshua Fitch, appointed Principal of the British and Foreign

School Society Training College in 1854, and promoted to the Inspectorate in 1863. His curriculum proposals comprised reading and writing, arithmetic, English grammar ('the classics of the poor'), a little geography and history, scripture, but no science. Instead of a thorough working knowledge of common and everyday things obtained by the direct study of science, as in Dawes' scheme, there were to be 'country walks, star gazing and domestic experiences' (Fitch, 1861).

When science eventually reappeared in the curriculum of the elementary schools, some twenty years later, it was in a very different form from that advocated by Dawes. A watered down version of pure laboratory science had become accepted as the correct view of science, a view which has persisted, largely unchallenged, to the present day. Roscoe (1874), a vigorous campaigner for this conception of school science, argued that the goal of pure science is 'personal communication with nature for its own sake'. Through this type of scientific enquiry, which was value-free and disinterested, 'habits of independent thoughts and ideas of free enquiry are thus at once inculcated'. In arguing that schools exist primarily to select and supply future scientists of talent, he described the teaching of science in schools as 'the means of sifting out from the great mass of the people those golden grains of genius which are too often lost amongst the sands of mediocrity'. This view of science was designed to develop an elite who conformed to the image of the pure scientist rationalized by the higher orders. Science had been allowed into elementary education once more, but this time on the terms of the ruling order, which effectively excluded the mass of the population from any meaningful scientific education. In this way it was ensured that the resource of scientific knowledge was available to all in principle, but only accessible in practice to the elite. Thus, it no longer constituted a threat to the existing social order.

Michael Young (1976) claims that science teachers continue to see the main purpose of science education as the supply of future scientists, with the consequent neglect of the science education of the less gifted. Curriculum decision makers, he argues, have social control motives in wishing to create a large, scientifically illiterate workforce, 'who see themselves as dependent

upon experts in more and more aspects of their life'. He further claims that those in power see it as desirable that 'except in the specific context of their work, and possibly in leisure pursuits such as car maintenance, our increasingly technologically dominated world remains for the majority as much a mystery as the theological mysteries of feudal times'. Whilst these latter claims may be extravagantly overstated, there is little doubt that in presenting science as an abstract, theoretical study, little provision is made for the future non-specialist. Alternative, non-academic courses, for those less successful in passing examinations, rarely provide a genuine consideration of scientific methods and issues. As a consequence, few would claim that contemporary British science education produces a scientifically and technologically literate citizenry.

What of the Future?

The thesis developed here is that the way in which school science is perceived is not the end result of inevitable progress in the disinterested search for 'curriculum truth'. Rather, it is socially constructed, being the product of particular sets of choices made by particular groups of people, at particular times, in furtherance of their particular interests. Thus, it represents the triumph of a particular interest group. In the words of Karl Marx:

> The ideas of the ruling class are in every epoch the ruling ideas: i.e. the class which is the ruling material force of society is, at the same time, its ruling intellectual force. The class which has the means of material production at its disposal has control, at the same time, over the means of mental production, so that thereby, generally speaking, the ideas of those who lack the means of mental production are subject to it.
>
> (Marx, 1845)

An attempt has been made in this article to explain the rapid rise and equally rapid fall of the Science of Common Things in terms of social control motivation on the part of the liberal reformers who supported it and the conservative

'establishment' which removed it from the curriculum. It may be possible to discern interest group conflict and implicit social control intent in many other episodes in the history of science education - for example in the nature study movement in the early years of the century (Jenkins, 1981), in the general science movement in the years immediately following World War One (Jenkins, 1979), in the Nuffield developments of the 1960s (Waring, 1979a, 1979b) and in the proposals of the Scottish Education Department (Millar, 1981b). Consequently, it is important that teachers are alert to implicit as well as explicit messages in proposals for new science curriculum initiatives (ASE, 1979, 1981; SSCR, 1984). In confronting such proposals, it is important to ask:

1. Whose view of what is appropriate school science is being advanced?

2. Whose interests are being served by the particular proposals being promoted?

3. Whose view of society is being projected?

These questions become even more relevant when confronting the increasing number of calls for children to consider science in its socio-economic context (HMI, 1979; DES, 1982, ASE; 1984). It is not by coincidence, and certainly not without historical precedent, that current proposals for science courses for the 'less able' are considerably more socially oriented and, therefore, susceptible to social control influences than the abstract, 'pure science' courses proposed for the high fliers.

Notes

1. More detailed information about the life and work of Richard Dawes may be found in Ball (1964), Henry (1867) and Layton (1972b).

2. Details of Dawes' teaching strategies and course content are provided by Layton (1973).

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7. THE DEVELOPMENT OF A SENIOR SCHOOL GEOGRAPHY CURRICULUM IN WESTERN AUSTRALIA, 1964-84

Colin J. Marsh

Introduction

This study investigates how a geography curriculum for senior school geography students was initiated and evolved over the period 1964-84 in Western Australia. There are a number of forces at work in any curriculum development activity and this case study is no exception. In the first section, major factors are outlined and considered within a decision-making model. Occurrences over the period 1964-1984 are then examined in some detail, in terms of two phases of development.

The Content

(a) West Australian Education System

There is a tripartite system of secondary schooling within the state of Western Australia and this mirrors a similar pattern which occurs in all other states of Australia. The major system is the state education department which provides secondary education for 70% of the school population. The Catholic Education system provides secondary schools for 14% of the school population, and independent private schools account for the remaining 16%. Schools are provided in urban and rural centres, often widely dispersed, over the one million square miles comprising the state of Western Australia.

The state education department teachers tend to be selected from those locally trained at the four institutions in Western Australia offering a four-year teacher education programme leading to a Bachelor's degree and a Diploma in Education.