IDEOLOGY AND SCIENTISM:
EDUCATIONAL ASPECTS OF SCIENTIFIC ASSOCIATIONS IN ENGLAND
c. 1660 - 1851

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ABSTRACT

IDEOLOGY AND SCIENTISM -
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It is the purpose of this thesis to illustrate
the role of class interest in the development of scientific
and technical education. This is done through an investi-
gation of scientific associations in England from approx-
imately 1660 - with the emergence of the Royal Society,
to 1851 - which is the year of the Great Exhibition of
London. Emphasis is placed throughout on the nature of
structural domination in an increasingly technocratic
society, and on the subsequent responses of the various
social classes to a rapidly changing social-power
relationship which was reflected in production techniques.
These differing perceptions and social actions are
described in terms of class-specific scientistic ideology
and scientism. The perspective is essentially Weberian,
and draws on the work of Herbert Marcuse and Jurgen
Habermas.

ACKNOWLEDGEMENTS

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INTRODUCTION - PROBLEMS AND METHODS

> "Education and science so naturally
> associate themselves in the mind
> that it is hardly possible to discuss
> the latter as independent of the
> former."
>
> *Nature* 1870 [1]

> "That the state of knowledge in any
> country will exert a directive
> influence on the general system of
> instruction adopted in it, is a
> principle too obvious to require
> investigation."
>
> Charles Babbage 1830 [2]

The most powerful force shaping people's lives

today is science when applied to industry.[3] Indeed, it

may be fairly stated that this relationship lies at the

core of this essay. However, due to the complex nature

of the 'system interaction' involved (allowing for a

rather liberal use of the word 'system' to refer to

science, industry, and society), this assertion of centrality remains mute until it is 'animated' by more precise direction and definition.

Firstly, what this thesis is 'about' is education - not education in the narrow class-room, curriculum sense (although this is certainly involved), but rather education in the broadest sense of the word. In taking this perspective, we find ourselves more generally focussed upon questions which revolve around the society as a whole - rather than the individual; around *social* classes rather than *academic* classes. Education, when viewed in this light, takes on a whole new dynamic quality which stems from the tremendous diversity of human interest, motivation, and activity - what many sociologists refer to as 'social action'.[4] As Harold Silver encourages, "it is necessary....to see education not just 'in context' (with all the lack of relationships that the phrase implies), but in society, as something of society, as forming and being formed by society."[5]

Secondly, our concern for education as a social component will be further guided by the fact that we will, throughout this essay, emphasize the role of science as a determinant (or, at least as a co-determinant) of the form and purpose of education as a respondent

to social needs. What this implies is that, in the pages that follow, 'science' will not be portrayed as a cold, objective activity. While this study accepts the elementary definition of science which refers to the organized attempt to explain natural and physical phenomena, it does not accept the numerous myths which see science as being socially-removed and value neutral.[6] Rather, science is seen here as being an activity which is pursued by people who are themselves willful participants in a highly integrated and highly complex social order. Thus, science - like education - is considered as a *social* institution which is directed by *social* action.

Finally, it is important to remember that this thesis is historical. It will not deal with education and science as they *are*, but rather, with education and science as they *were*. This does not undermine the usefulness of the work by operating as some vapourous academic altitude (to put it pejoritively). *Au contraire*, before being able to fully understand and appreciate our current place in history, we must first consider from whence we came -i.e. we must establish an historical context. The integration of society, education, and science is not new, and therefore an historical

approach is entirely appropriate if we are to comprehend (or attempt to comprehend) where we (Mankind) have been, where we are, and (possibly) where we are going.[7]

The *Oxford English Dictionary* offers many definitions for the word 'history', among them being (in composite form): "A written narrative constituting a continuous methodical record, in order of time, of important public events, especially those connected with a particular country....That branch of knowledge which deals with.... human affairs or actions." There is much implicit in this definition, among the most important concepts in terms of this study are (1) that history is concerned with *social action*, (2) that history attempts to *explain* this action, and (3) that history attempts to explain *significant* social events.

One might ask 'what is important or significant about science and education in an historical context?'. The answer to this query is especially simple when we recall - as was stated at the outset - that science (with education in close pursuit) is a prime mover in contemporary society. However, this response can be further explicated if we reflect upon the significance of the dates fixed upon to frame this study (i.e. 1660 - 1851).

Although some scholars - such as A.R. Hall[8] - place it earlier, the recognizeable commencement of western society's transfer from a belief system which found real estate, and (later) mercantilism, at the heart of power and the economy, to a secular, rationalist, industrial system which remains dominant today, can be firmly established in the seventeenth century. In the early years of our period (i.e. c.1650), the beginning of the general social shift from a sacred to a secular 'belief system' can be seen in the move by the 'progressive' intellegensia away from metaphysical problems and towards those of more physical or 'pertinent' concern; from an interest in theology and the classics, to economics and technology.[9] These individuals were, as we shall see, to nurture and develop Rationalism from the Baconian notion of the 'Science of Man' which emphasized the importance of practicality in intellectual pursuits. In this new conceptualization of problems, the Supernaturalistic reaction to the unknown was relinquished in favour of experience and empirically derived knowledge.

Throughout our period (i.e. 1660 - 1851), Rationalism gained definition and momentum, and more importantly - social acceptability. So much so that by the nineteenth-century, science had become essentially the major form of

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social cognition. By this time, Rationalism had become
Utilitarianism and had found a strong voice in Jeremy
Bentham and the Cult of Benthamism. Where Rationalism
had been strictly concerned with science and technology,
Utilitarianism was more involved with the application
of what was *popularly perceived as being* 'scientific
methodology' to problems in the social, economic, and
political arenas.[10] This social use of science can be
readily recognized even today as being 'the norm'. Thus,
to return to the original question, we can now see -
even from this cursory outline - that the study of
science and education in an historical context can
potentially provide insights into a relationship which
profoundly affects today's society. The relationship
being the interface between science, education, and
society.

It is easy to speak of 'society' as if it were a
single-celled organism, or a 'black box'[11], which
displays very simple stimulus/response correlations.
Nevertheless, it is essential for all researchers who
work with 'society' to constantly keep in mind (and this
study is no exception) the tremendous diversity and
highly variable nature of society and of its components.

In view of this, awesome complexity, it would appear that all the researcher can do - at least at this stage of human development - is to acknowledge the overwhelming multiplicity of man and his world, and then to continue to 'poke and pry' in an attempt to understand our individual and collective nature.

Undaunted by this reminder of our limitations, the philosopher - the scientist - the poet - the sociologist - and others continue to work on problems concerning 'society'. In so doing, they erect crude models which are intended to replicate, in form and function, the social structure.[12] These models, though in manys ways simplistic, are honest attempts to weave a three-dimensional tapestry depicting human existence in all of its forms. Each model necessarily 'begins' somewhere, and therefore reflects the bias or poverty of describing a multifaceted 'organism' from *one* perspective.

Such social theories may argue from economic determinism, social determinism, religious determinism, historical determinism, and so on. However, one of the most frequently adopted social theories involves the notion of 'social control'. This approach takes on many forms (e.g. economic, political, technological,

religious, or structural determinism) and may indeed
find definition in any number of combinations. As a
social theory, 'social control, is by no means without'
its critics, nor is it generally accepted. But it has
been used, developed, and re-defined by a number of
inf luentail social thinkers - among them being Marx,
Weber, Marcuse, and Habermas. The basic premise of this
theory is that, as the name suggests, groups of
individuals within society are made subservient to
other groups or individuals and that they are kept in
this position by (usually) a combination of economic,
political, technological, or ideological constraints.
These constraints may be imposed consciously or
unconsciously, physically or mentally, directly or
structurally.

Having moved rather quickly from science and
education to social control, it might reasonably be
asked 'how is social theory relevant to this eassay?'.
Again, the answer is direct and simple. As we will
recall from the definition cited earlier, 'history'
attempts to *explain* social events. In order to do so,
it is generally accepted[13] that social theory - like
a graduated transparency - must be overlaid onto the
event or series of events in order to 'measure' and

evaluate their significance. Hence, in the case of this essay, we have chosen to apply one version of the theory of social control (the transparency) onto a series of events in British history which are framed by the years 1660 and 1851. It may be useful to imagine that the 'unit of measurement' along the x-axis is education, and along the y-axis is science, and that it will largely be the correlates in which we are interested. Over the period of our concern, it is these points of correlation that can be seen in the mind's eye as representing the co-development and progressive institutionalization of science and education.

Therefore, this thesis will not only be concerned with simply the imposition of social control, but will (perhaps, more importantly) be concerned with the *evolution* and *impact* of science and education on society to such a point where, in the latter years of this study (i.e. post-1800), a social control scenario can be realistically discussed. By 'realistically' we mean that pre-1800, science and education were not sufficiently defined or developed to seriously consider them as major instruments for social control.

In talking of social control, the method of control with which this essay will be concerned involves - as

the title states - ideology and scientism. These terms have a familiar ring to them, but upon closer examination it becomes clear that they both require more precise definition.

As was mentioned earlier, most social theories suffer from the weakness that they represent only one perspective. This presentation is no exception, and thus, the definition of ideology which has been selected is sympathetic to the approach undertaken here. This definition, articulated by the noted sociologist Karl Mannheim, reflects a class-specific orientation and reads as follows:

> "an ideology is a complex of ideas
> which directs the activities of men
> *toward the maintenance of their position*
> *in an existing social order."*   14

Following this definition and the implications refered to above regarding science and education, this thesis will trace the co-development of education and science toward a Rationalist society which is itself guided by 'science' in its broadest sense. In this conception, science will be interpreted as developing a dominant, class-specific ideology and education will be viewed as supporting and transmitting this ideology.

In any theory of social control - whether the

educational or social imposition is direct of 'structural' -
there must exist a notion of the ''controller' and of the
'controlled'. Our model will suggest that it is the
emerging middle-class professionals/industrialists we
develop and use the scientific ideology, and that it is
the workers who are subjugated. However, as our definition
of ideology stipulates, the working class *cannot* share
the dominant belief system, and therefore, we have
differentiated the value system which they develop by
calling it a 'scientism'.

Strictly speaking, 'scientism' refers to the "slavish
imitation of the method and language of [natural] science,
especially by social scientists."[15] However, we have
adopted a somewhat tempered definition of the term as
meaning simply the misunderstanding of scientific or
(in the case of social applications) scientistic
principles. In this conceptualization, a misunderstanding
of the concepts which direct society is sufficient to
render and maintain a subservient working class to the
benefit of the dominant professional/industrialist
class.

In order to focus on the co-development and
progressive institutionalization of science and education,
we will use throughout this essay the emergence of

scientific associations in Britain from approximately 1660 - the year in which the Royal Society was formed - to 1851 - the year which marks the Great London Exhibition and (approximately) the end of the Mechanics.' Institute Movement as a major form of working class scinence and technical education . Within this framework, it is therefore the purpose of this thesis to show that:

(a) the professional/scientific ideolgy which is generated and utilized by the emerging middle class is *modified* as it filters down to the lower levels of society, and.that (b) the major secular belief system which ultimately reaches the working class (through education and other cultural vehicles) is a scientism, or scientific misunderstanding designed to perpetuate a social system based upon professional class privilege.

Evidence which supports this 'social control' scenario will be presented through a close analysis of the extensive literature, focusing primarily on the following:

> (1) Associational membership - In this regard attention will be paid to the social background and occupations which are involved in the various societies. Statements made by the management of associations regarding desireable membership will also be examined.
>
> (2) The *stated purpose* of the associations as opposed to the *actual activities*.
>
> (3) The content of group publications as a measure of the group perspectives.

Taken together, these provide valuable indicies of the
sorts of questions which interest this study. The main
sources being used are secondary, and therefore this
thesis will be largely a work of synthesis - relying
on the labours of many scholars. Archival and other
primary sources will also be drawn upon, although mostly
in an illustrative fashion.

LITERATURE

By way of primary material, newspapers, journals,

and (to a lesser extent) books, and magazines have
been extremely useful in providing insights into the
views and issues which gained currency in the period
of our concern.

Among the newspapers utilized were the *Manchester
Mercury* and the *Leeds Mercury* (1754 - 1791), the *Morning
Chronicle* (1820s), the *Northern Star* (1838-1846), and the
Beehive (post-1840); while primary magazines include
Blackwood's Edinburgh Magazine (1820s), the *Edinburgh Review*
(1840s), and the *Mechanics' Magazine; Museum, Register, Journal,
and Gazette* (1830s). Also of assistance were the *Memoirs
of the Literary and Philosophical Society of Manchester* (1780s)
and the *Transactions of the Royal Society of London* (1665 -
1851).

Better known, but only of help in an indirect sense
were Adam Smith's *Wealth of Nations* (1776) and Thomas
Malthus' *Essay on the Principal of Population* (1798). The
works of Charles Babbage (1830, 1851), W. Hutton (1783),
J.W. Hudson (1851), James Hole (1860), and Samuel Smiles
(1866, 1885) were also contributive.

The secondary literature on the various aspects of
science, technology, and education during our period
is indeed extensive. However, in the history of
education, there have been some outstanding contributions

made by (seemingly) a handful of scholars.

The following are among the essential reading in the field of the history of education: J.W. Adamson (1921 & 1930), Margaret Hodgen (1925), Mabel Tylecote (1957), Thomas Kelly (1957 & 1962), Stephen Cotgrove (1958), Brian Simon (1960 & 1965), Harold Silver (1963, 1965, 1970, & 1977), J.F.C. Harrison (1965 & 1971), Nicholas Hans (1966), P.W. Musgrave (1966), J. Salt (1966 & 1971), and Ian Inkster (1972, 1973, 1976, & 1977).

This list would be incomplete if it neglected to include the prolific pens of G.W. Roderick and M.D. Stephens (1970, 1970, 1971, 1972, 1972, 1973, 1973, 1973, 1973, & 1974). Other good works are those of R.D. Roberts (1901), Oliver Stanley (1923), T.H. Huxley (1924), Eduard Lindeman (1926), Joseph Hart (1927), H. McLachlan (1931), F.W. Reeves, T. Fansler, and C.O. Hould [*The Regents Inquiry*](1938), H.C. Dent (1946 & 1949), Robert Peers (1958), Theodore Schultz (1963), M. Argles (1964), Sidney Pollard (1968), A.E. Dobbs (1969), Joan Simon (1970), John Lowe (1970), W.H.G. Armytage (1971), C. Webster (1971), Clifford-Vaughan and Archer (Eds.)(1971), Margaret Gowing (1978), Richard Johnson (1979), and R.A. Thomas (1979).

Useful, though not essential, readings are J.N. Hays (1964), L.J. Hume (1967), A.R. Marcham (1970), D.J. Rowe (1970 & 1973), B. Rosen (1974), D.G. Long (1977), W.H. Brock(1979), and B. Taylor (1979).

The works indicated here cover a broad spectrum of subjects which, in some way, deal with our central theme of education and scientific associations from 1660 to 1851. It should be mentioned that this listing is in no way exhaustive or complete, however, the studies indicated are among the more helpful.

On the questions surrounding literacy and education, a topic which carries direct implications for our study, the work of Patricia Hollis, especially with respect to working-class radicalism and the press (1970, 1973, & 1974), as well as the major contributions made by R.K. Webb (1968), Lawrence Stone (1969), and Thomas Lacqueur (1976) are highly recommended. Also worth review are the books by B. Farrington (1949), R.C. Cochrance (1956), and James McClellan (1979).

The history of science is also well documented, and many studies have been of great use in the preparation of this thesis. Although little direct attention is paid to education (either formal or informal), the information does lend itself to

interpretive educational analysis. Some of the more

prominent and useful works are those by J.D. Bernal

(1946 & 1971), the Clows (1952), D.S.L. Cardwell

(1957, 1971, & 1972), J.G. Crowther (1962), David

Landes (1969), Robert K. Merton (1968, 1970, & 1973),

John Osbourne (1970), Alan Ferguson (1972), Jonathan

and Stephen Cole (1973), Richard Whitley (1974),

Barry Barnes (1974), and Edward Hughes (1975). Other

essential readings included Joseph Ben-David (1956),

Barber and Hirsch (1962), J.L. Clifford (1968),

Musson and Robinson (1969), David Knight (1970),

Peter Mathias (1972), Teich and Young (1973), Jacob

Bronowski (1975 & 1979), as well as the edited works

by Jones and Cohen (1963) and Basalla, Coleman, and

Kargen (1970).

Pertinent supplemental material can be found in

G.N. Clark (1937), W.P. Jones (1937), James Kendall

(1942), G.A. Foote (1952), A. Wolf (1962), Witt

Bowden (1965), M.W. Flinn (1966), A.R. Hall (1970),

and Bernard Gendron (1977).

There exist less numerous, though nonetheless

excellent, studies on scientific societies; both in

general and in particular. Among these, some authors

have acknowledged the educational importance of

their works and have thus paid at least passing
attention to the implications and problems of adult
learning. This has usually been done in an
integrative manner. Among the best are Eric Robinson
(1953, 1954, 1955, 1955, 1957, & 1963) and Robert E.
Schofield (1955, 1956, 1957, & 1963). The works of
Ian Inkster (1977) and A.D. Orange (1970) also focus
on provincial science.

Good studies which focus on aspects of the Royal
Society of London include A. Geikie (1917), M. Purver
(1967), H. Lyons (1968), Christopher Hill (1968),
Dorothy Stimson (1968), R.M. MacLeod (1971), T.E.
Allibone (1976), and the edited work of Cope and
Jones (1966). It should be cautioned that of the
above noted pieces, those of Lyons and Geikie suffer
from extreme prejudices and invite suspicion regarding
their accuracy. These, therefore, must be dealt with
carefully.

An excellent and useful examination of the Royal
Institution of Great Britain is that of M. Berman
(1978); while other worthwhile readings on this topic
include T. Martin (1944), D. Thompson (1957), and
F. Redlich (1971).

Among the more excellent social histories covering

this period are the works of E.J. Hobsbawm (1962 & 1977), E.P. Thompson (1968), Harold Perkin (1969), and J.H. Plumb (1972 & 1976). Somewhat more narrowly, however nonetheless critical in social analysis, have been the sociological perspectives of Stephen Cotgrove (1958 & 1976), R.S. Neale (1968), C.M. Turner (1969), and Arnold Thackray (1974).

The economic perspectives which speak to this study are especially well documented. The following are included among the more noteworthy authors: Asa Briggs (1960), T.S. Ashton (1961), Phyllis Deane (1965), Christopher Hill (1969), and R.M. Hartwell (1970).

Authors dealing with more philosophical or religious aspects of science and education include Irene Parker (1914), D.C. Somerville (1929), M.G. Jones (1938), H. McLachlan (1943), R.L. Greaves (1969), C.M. Elliott (1970), Elie Halevy (1972), Richard Olson (1975), Harry Payne (1976), Franklin Baumer (1977), J.J. Hurwich (1977), and James Billington (1980).

More general pieces can be found in Bill Whyte (1946 & 1959), B.D. Bargar (1956), M.V. Harcourt (1970), J. Money (1971), R.N. Price (1971), Janik and Toulmin (1973), Stephens and Roderick (1974), Martha Ornstein [Bronfenbrenner] (1975), D. Allen (1976), R. Porter

(1978), and A. Toffler (1971).

Finally, works which have beem central in the
development of a conceptual perspective have been
Max Weber's *The Protestant Ethic and the Spirit of Capitalism*
(1958), his essay 'Bureaucracy' (1976), and Herbert
Marcuse's *One-Dimensional Man: Studies in the ideology of
Advanced Industrial Society* (1966)..

Also of help in this context were Aldous Huxley's
Brave New World Revisited (1969) and Jurgen Habermas' essay
Technology and Science as Ideology (1971).

ORGANIZATION

In order to approach an understanding of the impacts
of the associational mentality upon educational thought,
the educational process, and upon the development of the
educational system, the following divisions will be used
to idolate important aspects of the discussion.

Consistent with the broadly chronological format which
this presentation will follow, a first chapter will investi-
gate the emergence of that typically English institution -
the Club - from within the coffee-house. It is in this first
major section that the important role of the coffee -
houses in supplying an environment which was conducive

to the development of a variety of class-specific ideologies will be examined.

In this context, the discussion will include both the occurrance of the formal, specialized associations as well as the more informal, 'news-oriented' gatherings. In order to do so, it will be necessary to introduce the closely associated themes of literacy and the press, as it is during our period that both the scientific journal and the newspaper make their appearance. Indeed, these tools (as well as the pamphlet, book, and magazine) can be seen as serving in the adjustment (disruption) of social ideologies.

With these topics, then, it will be possible to investigate the educational implications which are inherent in the early history of the development of the scientific association. Also, it is in the concomitant refinement of group ideologies (which are, themselves, manifested through the various activities of the associations) that we can witness the beginning of the shift in the social definition and expectation of education, in the relation of education and scientific societies to economic growth, in the revision of class barriers, and in the resultant awakening of a 'new' or 'sharpened' middle- and working-class consciousness.

Moving from the general context of the coffee-
house, the next chapter will deal more particularly
with the early London-based societies. Specifically,
we will examine the Royal Society of London (1660).

In so doing, we will direct our attention to those
isses concerning the Baconian impetus behind the
formation of the Royal Society, the stated intentions
of the founders, membership patterns, and the published
and reported activities. In this way, we will be able
to ascertain the existence, within the Society, of any
class-interest, be it conscious or unconscious; and if
such a pattern is found, we will then question whether
or not there is any evidence to support the ideological
interpretation which we are suggesting here.

It is important to note that the sources for this
section are particularly rich as, not only will we be
dependant upon secondary sources, but these sources
will be greatly supplemented by the actual *Transactions
of the Royal Society of London* which are available commencing
with the first publication in 1665.

The subject of our third chapter will be the
provincial associations. In this section, we will draw
from a much broader sample, dealing especially with
the Lunar Society of Birmingham, the Manchester Literary

and Philosophical Society, the Derby Philosophical
Society, and (for comparitive purposes) the London-
based Royal Institution of Great Britain.

While, chronologically, the topic of the previous
chapter (i.e. the Royal Society) covers the entire
period of our concern (i.e. 1660 - 1851), our discussion
of the provincial associations and Royal Institution
covers the period from 1760 to 1851. For ease of
comparitive analysis, the issues which drew our
attention regarding the Royal Society will also be
operative here; however, perspectives will be almost
diametrically opposed as the religious and political
affiliations of the provinces differed dramatically
from those of London. Nevertheless, after an analysis
of the activities of the provincial associations,
striking ideological and economic similarities will
become evident between the provincial and London
societies.

For example, while the professional scientific
ideology is evident within these organizations, *some*
of the social manifestations of their work represent
a significant departure from the accepted value system.
Indeed, this 'inconsistency' is, in fact, quite
'consistent' with the developing scientific value

system..

A final substantial chapter will be devoted to the Mechanics' Institute Movement which spans from 1799 to approximately 1851. It is here that all of the educational, ideological, economic, social, and political trends, which are evident in the earlier sections, merge.

While not, in the strictest sense, a scientific association, the mechanics' institutions represent a natural extension of those societies; natural, that is, in view of the increasingly important role which science and technology came to play in nineteenth century English economic, political, and social circles. Indeed, it is the mechanics' institutes which offer final 'proof' of the interpretation suggested by this thesis. This is found in the fact that the institutes, especially those in the industrial, or otherwise major cities, represented a fascinating combination of class-based ideologies. Although the notion of 'class' holds almost entirely different conotations when used with regards to, say, the early eighteenth century, the first half of the nineteenth century witnessed the development of distinct groups which, when speaking of mechanics' institutes, can be best exemplified by the confrontation in the early

London Mechanics' Institute between Francis Place and Thomas Hodgkin. The staunchly pro-middle-class Place, and the defiant pro-worker views of Hodgkin were equally vibrant in such a way as to leave both value systems highly visible. As Asa Briggs states, "the concept of social class with all its attendant terminology was a product of the large scale sconomic and social changes of the late eighteenth and early nineteenth centuries." With the factory replacing the traditional 'bonds of attachment' with a new 'cash nexus', the working class became increasingly unified and the middle class became a product of conscious pride.[16]

During this period (i.e. 1800 - 1851), due to the continued filtering down to society's 'lower' orders of scientized ideas and perceptions of reality, the industrial workers (including artisans, operatives, and craftsmen) became increasingly aware of the potentially liberating force of a scientific or technical education. To this group, 'liberation' was seen primarily in terms of *economic* liberation, and this ideal embraced a number of aspirations which can be summed up as 'upward social mobility'. These aspirations were not the result of a direct imposition of the professional/scientific ideology upon the workers from above, but were, more

accurately stated, an imposition which was a *derivative* of a social and industrial *structure* which *reflected* the profession/scientific ideology, and 'imposed' varieties of educational, social, cultural, and moral developments.

Although comparitively few (such as James Watt) succeeded in fully joining the professional class, they were seen by the workers as the real 'success' story. However, whenever these aspiring individuals finally 'arrived', it can be said that their 'trip to the top' was accomplished by embracing the values of the middle class. In particular, a close analysis of many of these indivuals backgrounds reveals an acceptance and mastery of the professional/scientific ideology (See Appendix F).

For the vast majority of the working class, this was not the case. The professional/capitalists who were encouraging and inviting the further scientization of society *also* became aware of the potential for scientific and technical education. To this group, the goal was increased production and worker docility. It is within the context of the mechanics' institutes that these two value systems, which first began their development and articulation in the coffee-houses, finally (in the nineteenth century) became major and openly conflicting class systems.

THE TRANSMISSION OF IDEAS:

THE EMERGENCE OF THE COFFEE-HOUSE, THE CLUB, AND THE PRESS

> "Coffee-houses make all sorts
> of people sociable; the rich
> and the poor meet together; as
> also do the learned and unlearned.
> It improves arts, merchandise,
> and all other knowledge; for
> here an inquisitive man, that
> aims at good learning, may get
> more in an evening that he
> shall by books in a month." [17]
>
> John Houghton, F.R.S.

The Coffee-House and the Club

The introduction to Britain in 1650 of the first
coffee-house (at Oxford) was to herald not only the
emergence of that typically English institution - the
Club -, and of an effective Press, but was also to
mark the identifiable beginnings of a new perception
of Man as a social being, and of his developing regard
or education in its broadest sense.

It is significant that these trends, though occurring
simultaneously, and sharing a common environment, were
peculiar to two distinct and seperate social classes.
The patrons of the more club-like activities were, on

the whole, highly regarded professionals and included among them the most renowned doctors, (natural) philosophers, artists, and poets. Individuals such as Benjamin Franklin, John Locke, Robert Southey, John Dryden, and Samuel Taylor Coleridge are well known to have frequented their favorite coffee-houses. Indeed, for John Locke, one of his discussions at such an establishment is said to have given rise to his *Essay On The Human Understanding* .

At the same time, the discovery of the utilitarian benefits of knowledge or practical information began to take place within the ranks of workers, craftsmen, and artisans. This is not to suggest that the common scene in a coffee-house was one of strict class division. *Au contraire*, it was here that, perhaps for the first time, class lines were not rigidly observed, and the vital, spontaneous expression and discussion of progressive ideas was the norm.[18] As Thomas Kelly states:

> "Before the Revolution in 1688,
> the coffee-houses were mostly
> temperance establishments,
> conducted under strict rules,
> and priding themselves in their
> orderly and democratic character.
> Any man who paid his penny,
> whatever his rank - knight or
> commoner, bishop or curate, rich
> merchant or poor apprentice -
> was entitled to take the first

> vacant seat, to expect civil
> conversation from his neigh-
> bour, and to participate in
> any conversation that might
> be going on." [19]

However, as the eighteenth-century progressed, the
coffee-houses became increasingly specialized, catering
to specific groups which often crystalized into formal
clubs. Indeed, as David Allen suggests, the early half
of the century might be described as the 'age of clubbing'
as every trade and profession had its favorite coffee-
house at which to meet. As this tendency towards
specialized assembly grew, there returned a conformity
and adherence to the recognition of class distinction. [20]

This shift was not unprovoked. After the Revolution
of 1688, many coffee-houses introduced the sale of
intoxicants and gaming; and open areas within these
establishments gave way to closed-boxes for private
conversation. Also, it was at this time that a broader
representation of society began frequenting the now -
popular coffee-houses, and this larger specimen
included the more criminal aspects.

It has been suggested that it was only natural to
expect to find an eventual influx of lower-class
individuals, and a simultaneous rise in the social -
misbehaviour of ruffians. [21] This view, however, finds

little currency among prominent historians. As both
J.H. Plumb and T.S. Ashton point out, all classes
were encouraged by their inhospitable and overcrowded
living conditions to seek entertainment and relief
from these conditions at the local public house and
coffee-houses. Such entertainment and relief was to
come in the form of exchange of opinion. Thus, it is
felt that voluntary social compactness (as found in
the Club, and as opposed to the *involuntary* compactness
as found in inadequate housing) is not only a
distinguishing mark of civilization, but is also, in
itself, a civilizing force.[22]

In order to illustrate the extent to which coffee-
houses permeated English society, by the beginning of
the eighteenth century in London alone, there existed
in excess of 550 coffee-houses (more than 2,000 in
England). And, in order to present an idea as to the
wide range of possibilities which were to be found
within these establishments, J.H. Plumb states that
"some, like Johnson's 'Club', added to our cultural
heritage; [while] others, like the apprentice's 'Cock
and Hen', were squalid breeding grounds of crime.[23]

Nevertheless, this was a period which bore
witness to the emergence of all kinds of clubs and

societies; and a widening concern with science and its practical applications resulted in a decided, increase in the number of organizations that paid particular attention to the various aspects of science.

The following merely serves as an example of the fertile environment which coffee-houses provided, and is not extensive: in 1721, a Botanical Society formed and met at the Rainbow Coffee-House; in 1735, a Society for the Encouragement of Learning was established at the Rainbow. Its general aim was the promoting of the Arts and Sciences. In 1745, an Aurelian Society took shape at the York Coffee-House and later developed (in 1788) into the Linnaean Society; in 1782, a Chemical Society was meeting at the Chapter Coffee-House; and it was at the Stock Exchange Coffee-House and Tavern that London's Stck Exchange was to form.

The scientific societies which emerged during the late seventeenth- and early eighteenth-centuries all sported members who, in some way, fit into what has been described as the 'gentleman amateur tradition.'[24] These included the leading scientists and philosophers of the time, and significantly, many amateurs to whom natural philosophy had become a fashionable hobby. This was possible as the qualitative sciences had not

as yet assumed the level of complexity which they were later to develop; and therefore, "any educated man with dextrous fingers could acquire, without difficulty, a sufficient command of the subject to experience the thrill of standing at the threshold of the unknown."[25] Whether progressive landed aristocracy or 'marginal' industrialists, artisans, and craftsmen, they were, nonetheless, developing, often through speculation and experimentation in its crudest form, some sort of expertise in science and technology. At this same time, they were developing their group scientific ideology.

However, these individuals in no way comprised the only members of society who were interested in science. A much wider segment of the population became enthralled by the wonders and possibilities of 'modern' science; but having no formal grounding in the underlying principles involved, these individuals (who were generally men and women of the middle and upper classes) could only participate in the Modern Age by way of elementary lectures and spectacular demonstrations. Here then lies a good example of middle-class scientism, as this group wished desperately to feel personally involved in 'Progress',

and yet were unable to fully comprehend the workings
of its principles. The result was an inappropriate appli-
cation of what was conceived to be 'scientistic methodology' (i.e.
rationality and empiricism) to every facet of society.

In response to the growing interest in science,
there arose a class of itinerant lecturers who were
able to earn a modest living by travelling throughout
the country and giving scientific lectures, courses,
and demonstrations by subscription. The first such
lectures that we know of were given by George Wilson
at his London home from about 1690 until his death in
1711. In 1691 he published a textbook for the use of
the gentlemen who attended.[26]

Initially, in the late seventeenth-century, such
public lectures were few, being mainly confined to
the large centers; but by the early eighteenth
century this began to change and change rapidly. By
mid-century, very few towns were without lectures; to
the extent that in 1766, Dr. Samuel Johnson stated
that "people nowadays have got a strange opinion that
everything should be taught by lectures."[27] And, in
fact, the majority of lectures were conducted at the
coffee-houses.[28]

Not suprisingly, these lectures were bitterly

opposed by the High Church of England as scientific.
rationalism was seen as a danger to religion and to
the existing bureaucratic power structures which the
sacred belief systems supported. This fear grew
considerably by the last quarter of the century as
these public lectures began to shift in content from
science to discussions of what the working- and lower-
middle-classes perceived as being more tangible areas
of concern – that is, political economy. Indeed, "what
began as scientific curiousity often ended in political
and moral speculation." [29]

This can be seen as being especially significant
in view of the fact that this emerging application of
rational and empirical inquiry to political and social
situations was taking place against the background of
what Eric Hobsbawm has called the Dual Revolution –
the French Revolution of 1789 and the British Industrial
Revolution. [30] In this connection, the public lectures
which sponsored this focus were not attended by the
prosperous or professional clientele, but were
directed towards working-class individuals. Indeed, it
was probably the high fees, and not a lack of interest,
which initially discouraged the attendance of operatives
and apprentices.

It was approximately at this point in the development of public lectures that Arthur Young conceived of an extension of the spirit and method of popular science demonstrations in which a system of education would be more adapted to the needs of a town of trade rather than the 'monkish system' which existed at the time. [31]

Overall, the important role of the itinerant lecturer, and of the public lecture which, even into the 1840s, primarily took place in the coffee-houses, were seen as being in the public interest; although by the nineteenth-century, lecturers themselves were no longer as transient as they once had been having become contractually attached to various institutions. By this time, however, the content of the lectures had declined into phrenology and animal magnetism. [32]

The Press

The coffee-houses were to play a significant role in the emergence of the newspaper, and it was through the unique form of association which typified these social halls that working-class literacy and political awareness were to receive a stimulus. Every profession

was to find social and political expression in corporate form within the coffee-houses, despite Walpole's Anti-Combination Acts of 1720 and 1744.

This sort of activity was certainly condoned within more liberal circles, as we have seen. One typical example of a popular establishment which catered both to the working-class and to their interest in politics can be seen in John Freeth's Leicester Arms Tavern in Bell Street. Popularly known as 'Freeth's Coffee-House', this establishment was "recognized as a forum for the transaction of business and exchange of news....The interest of Freeth's House in current affairs was openly avowed in 1772 by an advertisement headed POLITICS, which not only stated that its owner kept files of all the London papers for the previous thirty-seven years, but also that he received a personal report of speeches and votes in Parliament."[33]

At its extreme, this type of political activism resulted in the formation of Correspondence Societies whose general aims were essentially two-fold: "to spread Thomas Paine's ideas by reading his works, and to impress the government with the strength of the public opinion favourable to France. At the same time, they kept a correspondence with the National Assembly

in France, and with the various Jacobin clubs."[34] There

arose a large number of less radical and scientifically

oriented organizations from within the coffee-houses.

Throughout our period, the coffee-houses were to

remain essentially a meeting-place where the events of

the day were discussed, newspapers read, and news &

gossip exchanged. It was the 'popular press' that was to

be one of the single most effective distributors of news,

views, and general information. It is certainly reasonable

to suggest that without such a development, the redefini-

tion of social ideologies (which was to take place in the

eighteenth and nineteenth centuries) could not have

occurred. The press, voluntary associations of all kinds,

and open discussion all merged to form, for the working-

class in particular, a new political and cultural

experience. Indeed, as Harold Silver points out, "education

[in its fullest sense] and the press were....the main

unifying forces of the radical movement."[35] For the middle

class, however, this was not so much a 'new' experience as

a *broadening* of their cultural definition. Activites which

traditionally had been confined to the aristocracy, such

as philanthropy and 'the Opera', were now zealously pursued

by the emerging professionals. The fruits of their labours

were beginning to pay dividends.

Although not a 'radical movement' in the political

sense, the emerging scientific community, and those

interested in science, were perhaps the true leaders
of the social redefinition which was to become characteristic
of the period from 1660 to 1851. And as such, the new
scientific societies which arose both directly and
indirectly from the coffee-houses made quick use of
the advantages that the printed word had to offer.

The Scientific Journal and Scientific Magazine

This new phase started with the first appearance
of the scientific journal in the 1660s. Seen quite
naturally as a possible avenue through which to make
scientific work to others, its origins can be found
in the correspondences between scientists, and later,
between scientists and a few men who were to become
clearing houses for scientific information. Offering
a speedy alternative to printed books and personal
correspondence, the periodical of pre-1660 gave rise
to the scientific paper, with the 'clearing-houses'
requesting regular donations to be published.

The scientists were not alone in their reading of
these journals, as there was a great interest also
among amateurs. These amateurs were, somewhat later,
to include the English 'Romantics' such as Southey,

Coleridge, and Blake. Interest in science generally
was increased after the first number of the *Philosophical
Transactions of the Royal Society* (1665). In the physical
sciences, *The Philosophical Magazine* (edited by Alexander
Tilloch) was to become second only to the Royal
Society's publication. *The Philosophical Magazine* was
especially unique in that it was not owned by, or
affiliated with, any institution or scientific body.

The popularity of *The Philosophical Magazine*, and of
the publications of the Royal Society, the Royal
Academy of Arts, and the Society of Arts, was so
great that many volumes were repeated printed. To
illustrate the rapid growth of the scientific journal
(both popular and serious), Matthew Boulton lists a
total of seventy-four new journals which originated
between 1725 and the close of the century. This
figure, however, excluded purely medical journals.

The entertainment magazines of the 1750s and 1760s
vied with one another in catering to the tremendous
public interest in natural history, and as early as
July 1752, the *Universal Magazine of Knowledge and Pleasure*
proposed a series of coloured engravings and articles
to constitute a 'compendious System of Natural History'.
Other magazines which followed suit were (1759-60) the

General Magazine of Arts and Science, the *Grand Magazine of Universal Intelligence*, the *Royal Magazine*, the *Imperial Magazine*, the *Weekly Magazine*, the *Lady's Magazine*, and the *Royal Female Magazine*. The *Gentleman's Magazine*, *Ladies Diary*, *Edinburgh*, *Westminster*, and *Quarterly Reviews* also carried important articles on the state of science. It is important to keep in mind that while the seventeenth- and eighteenth-centuries focused their interests upon the study of (what we would call) physics, late eighteenth- and nineteenth-century interests shifted towards natural history. This, included, among other subjects, geology, botany, and zoology, all of which were to, in some way, speak to questions of theology. The great Darwinian evolutionist debates at the end of the century stand as examples.

As the vocabulary and metaphor of science subtly inserted itself into the English vernacular, more people began to feel at home with 'science'; and thus began a cultural 'love affair' with the scientific method (or what was popularly believed to be the scientific method). Nonetheless, people were anxious to feel involved. The extent of involvement, however, usually amounted to no more than possibly submitting

(on a regular basis) mathematical problems and
solutions - as did a great many people to the *Lady's
and Gentleman's Scientific Expositor*.

Accompanying the steady growth of reputable
scientific publications was the similar growth of
literacy among the public. By the last decades of the
eighteenth-century, the popular journals shifted from
a 'memoirs' style to one of a more specialized and
knowledgable sort. [36]

Literacy

The liberation of the 'fourth estate' (the press)
dates from the 1640's with the first appearance of
advertisement; and a further advance was to come after
1688 with the protection of the paper industry. Not
only were these events to play substantial roles in the
spreading of literacy and the dissemination of inform-
ation, but they were also to participate intimately in
the series of 'mini-revolutions' which were to occur-
especially in communications and the preservation of
records. [37]

It has been said that 'the illiterate are ever
children' [38] The validity of this statement can be seen

in pre-literate societies where the transmission of the cultural heritage relies exclusively upon the oral tradition:upon what can be remembered and passed on. Therefore, it is easy to speculate that any attempt by an elite, within such a society, to retard or manipulate the spread of literacy towards the maintenance or development of a social, political, or economic system which is consistent with elitist ideology, would necessarily be detrimental to the progressive ideologies of other, non-elite groups. Similarly, the art of reading potentially opened the door to new interests which threatened to replace the primacy of religion.

Such was the case between 1680 and 1780 when there was a noticeable decrease in the rate of growth of literacy, caused by a fear among the upper-classes that literacy had been a contributory factor in the revolutionary activity of the 1640's and 1650's. However, this decrease was not an *absolute* decrease, but was, rather, a decrease in the *rate* of growth. Hence, especially in the northern industrial towns and cities, there was a slow but persistent upward trend. Results in the Midlands were somewhat more dramatic as, between 1760 and 1800, the adult male literacy rate rose from 48% to 64%.[39] This is not to suggest that literacy had be-

come quite common-place throughout all levels of
society. Indeed, as J.F.C. Harrison points out, illit-
eracy remained very widespread amongst the working-
classes until the 1860's. One test of literacy at the
time can be found in marriage registers. For example,
in 1844, 32.4% of males, and 49.2% of females signed
these registers with a mark.[40] This in itself is not
unusual as there are numerous factors effecting both
education and literacy within a society. These include
the existing attitudes and realities regarding social
stratification, employment opportunities, religious
theories of social control, demographic and family
patterns, economic organization and resources, and
political theories and institutions.[41] In order to
affect any penetrating changes, these factors must be
orchestrated to produce an environment conducive to
the proposed alterations. As Lawrence Stone indicates,
one of these forces in particular was to play an impor-
portant role in establishing relations between science
and education. This force was religion;and more partic-
ularly, Protestantism.

This increase in literacy was closely associated
with the extension and availability of the newspapers
which spread most rapidly throughout the provinces,

and people discovered a wide diversity of public opinions, views, and information of all sorts. The number of publications grew with their increasing popularity. In the first half of the eighteenth-century there were in England a total of 25 papers and periodicals of every kind; by 1750 that number had risen to 90, by 1780 to 158, and by 1800 to 278.[42] These numerous publications were of various intent and represented a wide range of intellectual and social levels which were stratified according to interests and taste [43]

More than any other previous society, early industrial Britain was, to a large extent, based upon the written word. The socializing potential of print was quickly engaged in the shaping and developing of a new society. "Print helped destroy traditional attitudes towards work, and substituted new norms and goals."[44]

The demand for knowledge of every kind began to pick up momentum after 1660, and is evidenced by the first 'age' in the history of the press- this was the ' Age of the Encyclopedia ', of which John Harris' *Lexicon Technicum* was a classic example. To meet this growing demand for knowledge, hack writers were pressed into service in order to fill the gap, as there was an inadequate supply of books suitable for the new class

of readers. Two major problems were creating a new type
of literature which would cater specifically to the new
demand, and simply the provisions of access to the books-
that is, distribution.[45]

Distribution difficulties for both books and news-
papers were relatively simple to solve. To provide
access·to books and periodicals, libraries were estab-
lished. Chetham Library in Manchester, which had been
founded in 1653, was the first free public library in
the country.[46] The great popularity of both free and,
subscription libraries carried well into the nineteenth-
century and, in fact, was one of the traits which was
to be exhibited by the mechanics' institutes..

From the start, libraries were to take their educa-
tional roles very seriously, rigidly excluding even
general literature and fiction from the shelves.[47]
Even here, the religious and political connection to
libraries and education is evident. "Towards the end
of the [eighteenth-century], there was an obvious con-
nection between Dissenters, liberals, and libraries.
At Birmingham, eighteen out of nineteen members of the
committee who ran the library were Dissenters, led by
Joseph Priestly; [and] the originators of the London
Library were men with strong liberal biases, supporters

of America, and sympathetic to the early aspirations of the French Revolution."[48]

It must also be realized that, as Harold Silver points out, libraries signified the gathering momentum of self-help within the working-class community. It was through the acquisition of books and the availability of newspapers, as well as through discussion, that adult education became an observable reality in British life. This activity must be seen in the context of the new social and political awakening, which was in part stimulated by the French Revolution.[49]

Until the second half of the 18th century, the coffee-houses were to remain the focal point of social activity, providing access to newspapers, periodicals, and debate. The extent of the continued popularity can be attested to as, in 1727, a Swiss traveller wrote 'All Englishmen are great newsmongers. Workmen habitually begin the day by going to coffee-rooms in order to read the daily news.'[50]

Drunkeness and gambling were seen as being the natural enemies of reading and rational discussion. Reading and education came to be associated (in the early nineteenth century) by working-class

with a new group of cultural values. These values, the
results of a filtering down of a modified scientific
ideology, reflected a perception of reality not from the
point of view of the 'controlling', but rather from the
point of view of the 'controlled'. As Patricia Hollis states,
"the special cost of ignorance could be calculated quite
precisely from the size of prisons, the level of poor rates,
the frequency of death sentences, the number of public houses,
and the length of strikes....Only the newspapers could teach
the poor what the laws were, why they were to be respected,
and what would happen if they were broken."[51]

From this it can be clearly seen that reading and
education were deterents to crime, and potential forms of
social control.[52] This correlation between ignorance and
crime, which, as a popular viewpoint that gained currency
in the nineteenth century, can best be illustrated in a
few brief examples.

Although not alone, the *Edinburgh Review* spoke often on
the issue: "The only effectual prevention to crime is the
influence of Education. To educate the masses - to reclaim
neglected multitudes from that gross ignorance, and with
it those temptations to vice in which they were involved,
and to bring them under the influence of a wholesome,
intellectual, and moral training, is the great and permanent
duty of the English people."[53] Similarly, the "Twelfth

to both Houses of Parliament by command of H.M.
included a Plan for the Establishment of a General
System of Secular Education as education was the
only effectual prevention of crime."[54]

Not all individuals,(notably the majority of
the upper class), however, subscribed to these views.
For example, with the passage of the Ten Hours Bill
(1847), the leisure time of the working classes
increased. Thus arose the elitist attitude that the
lower classes were entirely absorbed in toil and
.sensual gratification. This has been correlated, by
J.F.C. Harrison, with the success of the beershops
and with an increase in social misbehaviour. This is
closely connected to the development of free trade
regarding beer.[55]

"If the diffusion of knowledge was society's best
insurance policy, then newspapers were the most
efficient means of informal education."[56] The emergence
of an effective press which spoke directly to the
questions and concerns of the working classes did not
go unimpeded. Beginning with the Printing Act of 1662,
Government censorship of books and newspapers, as
well as restrictions governing the number of presses,

printers, and booksellers, came into effect. If these mechanisms failed, the Royal prerogative, the medieval law of treason (under which two printers were hanged before the end of the seventeenth century), of the law of seditious libel could be used by the Government. In 1712, due to the lapsing of the Printing Act, the Tory Government introduced a newspaper tax of 1d. This rose to 3d. in 1776, and to 6d. in 1800. Newspapers thus became something of a luxury, and certainly priced the papers out of the reach of the poor. "In the autumn of 1830, just three months after the July Revolution in France had recharged popular radicalism in England, illegal unstamped anti-Establishment papers appeared on the streets of London, selling for a penny. Six years later, their circulation had far surpassed that of the stamped press."[57] A major thrust of the unstamped press was the right of the working man to a vote. As the unstamped press was illegal, it became one of the main tasks of the working-class radicals to print and circulate them.

As stated in the *Examiner* on 20 March 1836, "taxes on newspapers were taxes on knowledge, a sin against principle, for they taxed the free communication of ideas."[58] However, while the stamp remained, two

monopolies were maintained - the stamped press and the unstamped press. As Hollis explicates, "the Tories wished to maintain the stamp duties because they represented a property to the newspaper proprietors; the middle-class radicals wanted the repeal of the duties to break the monopoly of the existing proprietors, and to purify the stamped press by widening its readership beyond one segment of the society; the middle-class radicals were interested only in establishing a press of their own."[59] The middle-class radicals, led by Place, Birkbeck, Hume, Brougham, and Roebuck, together with the working-class radicals, led by Hetherington, Carpenter, and Cleave, claimed that an unstamped press was central to informal adult education; and both groups shared the view that "education was the working-class passport to politics".[60]

The unstamped press was very popular indeed; so much so that "in 1832, there were complaints that on Saturdays, people in the market-place in Leicester sold all sorts of papers, some quite profligate and blasphemous, calculated to set the lower orders against all that is decent and orderly in the land. In this kind of public defiance lay the political strength of the [radical] movement; the unstamped

press could be seen to be speaking out, by its very

presence, on behalf of [the] working-class."[61]

But the demand for the repeal of the stamp was

not simply because the middle- and working-class

radicals wanted to read the capitalist press at lower

prices. What they *did* want was a cheap press which

spoke to *their* interests, catered to *their* tastes,

guarded *their* rights, and demanded *their* entrance

into the political community. In fact, the demands of

the radicals reflected a larger concern that the

government be made accountable and responsive to

organized public opinion. "If the Government persisted,

in taxing newspapers, if it severed itself from the

popular will, then it made peaceful reform impossible,

and brought closer the possibility of change of a

bloodier sort. Does the Government prefer the March

of Intellect, or such 'marches as the French and

Belgians have lately made?' That was the choice."[62]

The stamp was repealed in 1836.

The appearance of an organized public opinion

first became evident after 1750[63] through the two

worlds of politics which existed in the eighteenth

and nineteenth centuries. On the one hand, there was

a tight political establishment which was linked to the provinces by a small group of powerful managers. This group controlled parliament. On the other hand, there existed an "amorphous mass of political sentiment that found expression in occasional hysteria and impotent polemic, but whose effective voice in the nation was neglible."[64]

However, from 1750 onwards, the number of connections between the 'political machine' and the masses were being multiplied rather than diminished. What can be witnessed in this period is the emergence of more direct relations between the State and a wider, more representative segment of the population. Although up to and including the early nineteenth century, the working class had not formally entered politics, they had become a political issue. With time, they were to become an independent political force.[65]

Evidence which indicates a recognition of the importance of education, and the need of a *citizen politisch* came from within the radical labour movement. The *Mechanics' Magazine* of 11 September 1824 reported that one group of mechanics articulated that "Nothing can persuade us but that all systems of education are

false which do not teach man his political duties and rights."[66] As proof of the longevity of this political stance, the *Northern Star*, some fourteen years later, cried - "WORKING MEN OF LEEDS - Now is the time to prove whether you are determined to have your Rights or whether you are willing to be everlastingly the Stalking-Horse and dupes of Faction!"[67]

After 1824, Utilitarian philosophy, which was extremely widespread and perhaps best exemplified by Jeremy Bentham, stimulated a substantial output of cheap pamphlets. Many of these were to be published by the Society for the Diffusion of Useful Knowledge (SDUK). Adhereing to this philosophy, working-class radicals declared reading as the touchstone of 'rational recreation', stating that 'no entertainment is so cheap nor any pleasure so lasting'. The working class were determined to read and discuss, especially on subjects of politics and economics, and the radical press provided the material. This press was extremely talkative, and provided a weekly set of comments on everyday life and politics.[68]

The underlying intent of several newspapers can be seen through the following examples: the motto of the *Brighton Co-Operator* was -

> 'Knowledge and Union are power:
> Power, directed by knowledge, is happiness:
> Happiness is the end of creation.':

that of a Birmingham pamphlet -

> 'Ignorance is the Curse of God:
> Knowledge - the wings wherewith
> we fly to Heaven!':

and that of the *Poor Man;s Guardian* -

> 'Knowledge Is Power'.

The *Poor Man's Guardian* was, perhaps, the vigourous of the popular radical newspapers of the 1830s, and had an extraordinary effect upon the daily papers throughout the country. They did not refer to the people as the 'mob', 'rabble', or 'swinish multitude', but rather as 'operatives' and 'working men'.[69]

As Brian Simon has noted, the production and sale of cheap journals, in concert with organized group study, was to form the core of educational efforts in the period from 1816 to 1823.[70] The literature used by the various socially active associations generally offered one voice of dis-satisfaction and defiance. This voice became particularly heated in the last decade of the eighteenth century as the more popular working class reading material included Malthus (1797) and Paine (1793). The sale of the *Rights of Man* was, at the time, estimated at 200,000 copies; and the

Sheffield Society for Constitutional Information declared that "we have derived more knowledge from the works of Mr. Thomas Paine than from any other author or subject." [71] These readings, plus the recent memory of the French Revolution, proved to be catalytic when coupled with the destablizing affects of the British Industrial Revolution. [72]

After 1850, however, the adaptation of the literature market to changing intellectual trends revealed an increase in publications generally, but a decrease in self-improvement literature.[73]

Summary

As we have seen in the foregoing pages, the coffee-houses were sociologically and ideologically significant in that they provided an environment which proved to be conducive and catalytic to the transmission of progressive ideas. Being initially frequented by upper middle-class professionals and industrialists ('marginals'), the coffee-houses witnessed, at first, a blurring of long established class lines. However, through discussion, each group recognized in the other mutually supportive and complimentary traits. These

included, for example, the professional's knowledge of science and the industrialist's knowledge of manufacture and the market (although religious and political views were also often compatible. With time, the two groups merged in their activities, unified by a new and distinctive cultural value system or ideology which placed its belief, not in traditional religious systems, but rather in science and technology.

To this group, as Weber stated, *die Entzauberung der Welt* was inevitable.[74] The control of Nature was now potentially within the grasp of Man - her secrets could not be withheld from the power of science.

From these groups developed specialized clubs which spoke directly to the interests of the members (i.e. natural philosophy), and which engaged in infromal educational activity. This activity found its form most often in intellectual discussion which performed the dual role of being both a stimulant to further educational pursuit, and to the refinement of their science-based ideology.

Another social group was to join the clientele of the coffee-houses, and these were the lower middle class and working class apprentices. This wider group also found

the discussions on popular topics to be extremely
stimulating, however, their 'realities' (in terms of
living conditions and daily life experiences) were
radically different from those of the professional
classes. Therefore, in this case, class barriers
tended to be re-enforced rather than dissolved,
forcing the workers to associate more amongst
themselves.

Having no expertise in science, manufacture, or
the market, they resorted to the reading and discussion
of daily news. The popularity of this activity
resulted in a slow, but significant increase in
literacy (especially among the lower middle-class);
and in a heightened interest in, and understanding of,
political economics. Parallel to the example of the
professional classes, this developing interest in
politics and the economy, among other things, resulted
in the development, *not* of a professional/scientific *ideology*,
but rather, of a more ill-defined, working-class
belief system, which was founded in the activist
tradition.

For both groups, whether guided by science and
its applications, or propelled by social dis-satisfaction,
the coffee-houses were certainly instrumental in the

development of class-specific cultural values and belief systems. In either case, early indications can be seen in terms of the changing social definitions which arose as the result of the increasing seculari- zation (and scientization) of society. Consequently education, as a reflection of the socio-economic milieu in which it operates, slowly began to reflect the expectations of the more 'rational' society.

III

THE ROYAL SOCIETY OF LONDON

Prior to the seventeenth century, the accepted
intellectual outlook was content with a scholastic
logic which was applied to a Nature which was arranged
by hierarchies. However, the Scientific Revolution
replaced this Ancient logic of descending, or linear,
order with a more intricate and complex world view.
This new system linked the rational and the empirical;
thought and fact; theory and practical experiment.

The effects of this intellectual shift were not
immediately discernible, though by mid-century,
theology and the humanities were no longer as highly
regarded as they had been; and science, as a social
value, rose conspicuously in the scale of estimation.

In Europe, as a whole, men of Protestant origin
were more numerous among scientists than were Catholics.
As Joseph Ben-David tells us, "although the data on
the religious background of scientists are not entirely
reliable and it is difficult to estimate precisely the
size of the religious communities from which they came,
all the existing computations show that Protestants

were disproportionately highly represented among
scientists from the sixteenth- to the end of the
eighteenth-century."[75]

However, as Puritanism was, in many ways, represent-
ative of the first Moderns, it was similarly indicative
of the last of the Ancients or medievalists. In one
sense, Puritanism led inevitably to the absolute removal
of restrictions on scientific work. Science was to be
nurtured as it would lead to the improvement of Man's
lot on earth. However, at no time did Puritanism
sanction a simultaneous relaxation of religious
discipline over personal conduct. In fact, quite the
contrary was true.

The world and Nature could only be conquered and
controlled through direct action, and this compulsion
had to be reflected in every sphere of activity. This
juxtaposition of the spiritual and the materialistic
is significant and characteristic of Puritanism. As
Robert Merton states, "Puritanism itself had imputed
a three-fold utility to science. Natural philosophy
was instrumental first, in establishing practical
proofs of the scientist's state of grace; second, in
enlarging control of nature; and third, in glorifying
God. Science was enlisted in the service of the

individual, society, and the deity."[76] Thus, through
Puritanism, empiricism and rationalism had become
canonized.

It must be remembered that while the majority of
scientists were Puritan, the majority of society was
not. Hence, it is not suprising to find that throughout
the 16th & early 17th century all scientific studies,
including mathematics, were considered to be closely
associated with the 'Black Arts'; and that the
practitioners of these studies were taken to be, not
only atheists, but 'limbs of the devil'. The strength
of such sentiment is attested to by the fact that the
universitites, which were strongholds of traditional
ecclesiatical feelings, remained unresponsive for so
long to the new, pratical subjects. Instead, country
records abound with cases where the local gentry
educated their sons at home rather than "allowing them
to become polluted by the Black Art of mathematics'.[77]

The ensuing 'competition' between traditional
religion and science was, almost certainly, the cause
of great emotional tension. Natural philosophy brought
all accepted systems into doubt. As the Anglican
clergyman and poet, John Donne, wrote in 1611 with
reference to the Coperican system of astronomy: "Tis

all in pieces, all coherence gone". [78]

However, the 'winner' was to be science, as it offered a new charm and prestige. With time, English society was to become more secure than any other previous society in its belief that they were utterly in control of their destinies. This view is highly visible from the late eighteenth century onwards. For example, Asa Briggs points out that "to the men of the 1780s.....the discoveries and improvements of their own generation seemed to diffuse a glory over [England] unattainable by conquest or domination." [79] Benjamin Disraeli was to, in his time time, echo this view: "what Art was to the ancient world, Science is to the modern....Rightly understood, Manchester is as great a human exploit as Athens." [80]

Francis Bacon and the Royal Society

When considering the rise, in both popularity and effectiveness, of eighteenth century science, recognition is given to the influence of Francis Bacon (1561-1626) who was the first great English materialist philosopher. This populariser of science and the scientific attitude had a profound, albeit indirect,

effect upon education. Advocating the advancement of learning, and the application of learning 'for the relief of man's estate', Bacon viewed education as a means both to social progress and to a deeper understanding of Nature. In so doing, Bacon specifically seperated science and religion, thus inviting support from Puritans, as the 'New Philosophy' allowed the pursuit of the scientific approach while, at the same time, furthering religious ends.

Bacon's approach was significantly different from the 'Chain of Being' approach which typified traditional beliefs and outlooks. The central strongholds for these established value systems were the universities; and it was within these institutions that Bacon saw the main cause for academic paralysis. It seemed strange to him that the colleges of Britain and Europe devoted themselves solely to professional preparation (e.g. law, theology, and medicine) rather than the study of arts and science in general. For Bacon, both were essential. However, since the Renaissance, most educational writings had been concerned with the perfection of the liberal arts curriculum, the details of which became enshrined in the statutes of the humanist schools and universities.

In the seventeenth century, there was increasing
dissatisfaction with this educational order, and
criticism reached a peak during the Puritan Revolution.
This period witnessed the exertion of pressure for the
complete reconstruction of the church and social
institutions, as well as a wave of enthusiasm for
'social experiment'. To Bacon, the educational reformers
of the Renaissance (such as Roger Ascham and Johann
Sturm) had successfully emancipated language from the
primitive hold of the medieval scholastics, but in so
doing, had deflected learning in the wrong direction –
towards eloquence and stylistic perfection, or the
study of words, rather than towards the study of
matter.

For the Moderns, of whom Francis Bacon was a proto-
type, the contemplation of the ancient wisdom of the
classics paled in the light of new scientific knowledge
and the subsequent utilitarian potential. And for the
Moderns, it was precisely the practical and the
utilitarian that mattered most. Their position embraced,
or was compatible with, a materialistic ideology which
sought the physical prosperity of society. In this
connection, Bacon provided a unifying programme and
philosophy of co-operative action (in *Novum Organum* [1620]

and *New Atlantis* [1624]) which demonstrated the ways in which science might improve methods of manufacture. On this point, Rene Descartes agreed. 'Instead of the speculative knowledge now taught in schools', he wrote in the *Discourses On Method* (1637), 'we can find a practical one whereby, learning to know how nature works, we can make ourselves masters and possesors of nature.'

It was, thus, in accordance with Baconian philosophy and cosmology that the Royal Society of London came to be founded. In fact, it may be justly stated that the Royal Society constitutes the greatest memorial to Francis Bacon, and it is fair to view the Society as the embodiment of Solomon's House, with the Fellows fulfilling the roles of the Merchants of Light (as per Bacon's *New Atlantis*). The Royal Society, following Bacon, declared that a new system of natural philosophy must be built up; and, as Bishop Sprat has stated, this new philosophy was intended (by the Royal Society) to be specifically for the use of cities. In this scheme, the inclusion of the study of trades, as advocated by Bacon, was primary. Thus, coupled with the main strategic objective of conquering and utilizing Nature, the importance of the trades became realized, and subsequently sanctioned as a 'proper' subject for

natural philosophers.

For the progress of learning, Bacon stated that there 'should be a brotherhood of men of learning and illumination, as there is in religious orders.' Hence, the implication that science should enjoy the stimulation of communication and organization. Indeed, a 'college' plan, which reasonably describes the Royal Society, is the 'Universal College' of the Moravian educationist - John Amos Comenius - as set out in his *Via Lucis* (1668). This is significant, as J.W. Adamson points out that the philosophies of both Bacon and Comenius were influenced by the other.[81] Certainly the Baconian influence in England received a revitalization in 1641/2 when Comenius visited. It was during this stay that his ideas were interpretted for English readers by Samuel Hartlib and John Dury.

Nevertheless, what the Baconian-Comenian tradition merged to do was to recognize the need for technological and agricultural education for the lower orders of society, which would enable the workers to improve the work in which they were engaged. And to this end, reform was sought. In these philosophies, it would be the role of the professional societies to facilitate and spearhead this attack.

As Bacon wrote in 1603, 'the opening of the world by navigation, and commerce, and the further discovery of knowledge should meet in one time or age.' Towards this goal, he felt that all science would be perfected in a few years; a view that was to continue as William Petty himself believed that the impediments to science and England's greatness were removable.[82] Thus, in trying to promote the marriage between natural philosophy and industrial production through an organized, learned body, Francis Bacon developed a belief in individual capacities, in expert knowledge, in what Eric Hobsbawm has called 'the citizen of the future'.[83]

Gresham College and the Royal Society

One of the earliest attempts to establish a center for adult education in Britain was in 1581 when Sir Thomas Gresham, through his Will, endowed a college. Gresham House in Bishopsgate was left to the City of London and the Mercer Company, and upon the death of Lady Gresham in 1596, the mansion was converted into a college. The endowment provided for the appointment of a total of seven resident bachelors who were to

lecture; each on one specialization. The subjects to
be offered were astronomy, geometry, physick, music,
rhetoric, divinity, and law. Lectures were to be
given on a specified day each week of the regular
term. The salaries of the Gresham Professors was 50
Pounds per year plus room & board; and lectures
officially began in 1598. These lectures proved to
be popular and attracted the leading men of London,
including nobles and courtiers.

These lectures continued succesfully into the mid-
seventeenth century when Robert Boyle, John Wallis,
Theodore Haak, John Wilkins, and William Bell became
employed by, or otherwise affiliated with, Gresham
College. Indeed, according to Dr. John Wallis, it was
the German immigrant - Theodore Haak - who first
suggested a series of meetings which would be
specifically modeled after the Baconian/Comenian
tradition.

A group, led by Wallis, took up Haak's suggestion
around 1645, as did a second group which was led by
Robert Boyle. Boyle, a physicist and chemist, called
the group which met with him 'The Invisible College'.
This group met at Gresham College during term, but
during vacations they conducted their business most

often at the Bull Head in Cheapside; although they are known to have frequented the local dining-clubs and coffee-houses as well. As Margery Purver tells us, both the members of the 'Invisible College' and the professors of Gresham College could be identified as Puritans in religion, and utilitarian in secular aims; while philosophically, they rigidly adhered to the writings of Francis Bacon.[84]

Wallis' group, which included John Wilkins, Ralph Bathurst, and Christopher Wren, did not meet regularly and slowly fragmented. The members pursued their personal careers, with some success. For example, in 1648, John Wilkins (who was later to become the Bishop of Chester) was appointed Warden of Wadham College, Oxford. John Wallis was also destined, in that same year, to go to Oxford. Having earned the favour of the Lord Protector, Oliver Cromwell, by breaking enemy cyphers, Cromwell, as Chancellor of Oxford University, showed his appreciation to Wallis by turning out Royalist professors in order to make room for Wallis, and men like him.

Other London members of Wallis' group moved to Oxford, and meetings resumed; first at the lodgings of William Petty, and later in the rooms of John Wilkins.

Under the firmer direction and organization of Wilkins, the Oxford group became more formal, crystalizing finally in 1651 into the Philosophical Society of Oxford. Despite the eventual return of some of its leaders to London, the Oxford Society continued to hold meetings until 1690.

Throughout this period, both the Oxford group and the 'Invisible College' maintained close association and contact until Christopher Wren, Lawrence Rooke, and others returned to London. And it was in the later years of this period (probably 1648) that William Petty, himself a practical businessman and Baconian, proposed the erection of a *gymnasium mechanicum*, or college of tradesmen, in which the mechanical arts would be taught. Petty envisioned a university of the natural world and called it 'the epitome of the whole world'. [85]

From this point on, Gresham College was to encounter difficulties. In 1658, both meetings of the 'Invisible College' and the Gresham lectures were stopped as the building was converted into a barracks for soldiers. A temporary return to normal (at least for lectures) was achieved in 'that wonderful pacifick year' of the Restoration (1660), however, the lectures were once again interupted in 1666 due to the Great

Fire of London. A more lasting disruption was to follow
the fire as the seven Gresham professors did not, for
various reasons, fulfill their obligations; the
consequence being that the Government stopped their
salaries in 1669.

However, the public demand for the lectures was
great, and in 1706, a special Committee was set up
which petitioned the Lord Mayor of London, Sir Thomas
Rawlinson, for the resumption of the Gresham lectures.
The request was accepted and the lectures were resumed.
They continued until 1768 when the building was sold
to the Government for use as the Excise Office.

An indication of the popular sentiments held about
science and Gresham may be gleamed from a brief excerpt
of a ballad written at the time, entitled simply: 'The
Ballad of Gresham College':

> 'This College will the whole world measure,
> which most impossible conclude,
> And navigation make a pleasure,
> By finding out the longitude.' [86]

From Restoration to Crystal Palace

As has just been seen, the 'Invisible College' of
Gresham College was forced to vacate the premises in

1658 due to military occupations. However, this did not
mean the end of the Gresham Philosophers (as they were
called); rather, they continued to meet in a more
impromtu fashion, at local coffee-houses, dinner-clubs,
and at private quarters. And with the recommencement of
the Gresham lectures in 1660, came the return of the
Gresham Philosophers to continue their meetings in the
more permanent, and familiar surroundings. There was
to be one major difference.

On Wednesday, 28 November 1660, a group of a dozen
men met in Gresham College. All of them were interested
in experimental and natural philosophy, and four of them
were the Gresham Professors of astronomy (Christopher
Wren), geometry, music, and physick (Dr. Jonathan
Goddard). At this meeting, the group of friends decided
to initiate formal meetings which were to be held on
Wednesday afternoons in the chambers at Gresham College
of Lawrence Rooke during term, and at William Balle's
in the Temple (Grays Inn) during the vacation.

Among those involved were Dr. Ralph Bathurst, Sir
Christopher Wren, Lawrence Rooke, Sir William Petty,
Rev. John Wallis, Dr. Jonathan Goddard, Dr. John Wilkins,
Hon. Robert Boyle, Theodore Haak, and William Balle. It
was decided that an admission fee and a weekly fee

would be charged; and before this meeting was adjourned
the names of forty others who might be expected to join,
or otherwise support, the Society were collected.

Thus was the unassuming beginnings of the formalized
'gentleman-scientist tradition'; *and* of the Royal Society
of London. This marked an important episode in
intellectual history, in the history of philosophy and
science, as well as in the history of education.

At the time of their formalization, the Gresham
Philosophers (as they had not yet received a Royal
Charter) embraced a new philosophy and a new scientific
attitude; both based on the Baconian tradition. It was
to become, throughout England, the mark of a 'cultured-
man' if he dabbled in both science and technology;
however, as we shall see, this emphasis on amateurism
would eventually lead to the decline of the Royal
Society, and of English science generally.

From the very beginning, the Society asserted that
the advancement of technology (generally), and transport,
navigation, and communication (specifically) were the
chief aims of the group. The reasoning behind these
interests was quite clearly economic and nationalistic
in origin. For example, in the *Philosophical Transactions*
of 1684 [14, p.660], William Petty, when discussing

the economic advantages of canals and turnpikes, states
that: "The water carriage of goods around the Globe of
the Earth is but about double of the price of Land
Carriage from Chester to London of the like goods." [87]
Though probably somewhat exagerated, this comparison is
nevertheless striking, and reveals an interest and
concern for economics, distribution, and the national
market.

However, as Robert Merton tells us, it is interesting
that while "the scientific coterie discussed without end
technical problems of immediate concern for the profit
of the realm", they were also under "varied pressures
exerted upon [them] by society, the King, and interested
nobles, to devote [their] studies to things of use." [88]

This was not a difficult request for two reasons.
On the one hand, the Fellows of the Royal Society (who
had been steaped in the Baconian tradition) were
initially pre-occupied with the practical. Jacob
Bronowski and Bruce Mazlish state that it has been
estimated "that nearly 60% of the problems handled by
the Royal Society in its first thirty years were
prompted by practical needs of public use, and only
40% were problems in pure science." [89]

On the other hand, England was becoming increasingly

industrialized. Therefore, there arose an increasing need

for 'technological fixes' to such national problems as

as the timber famine, transport, and communication.

The Royal Society, as it would be the sole centralized

body at the time, would be the only place to go.

One and a half years after formal meetings had

commenced, on 15 July 1662, Charles II expressed a

new attitude on the part of the monarchy and a hitherto

hidden scientific curiousity, when he granted to the

Gresham Philosophers a Royal charter. Thus, the formal

name received from the throne was the Royal Society of

London for the Promotion of Natural Knowledge. The

fact that a charter was even considered by Charles II

is, in some ways, suprising as of the total of sixty-

eight early Fellows of the Royal Society about whom

we have information "forty-two were clearly Puritans.

Charles II can hardly have been enthusiastic giving

his name to a society which was dominated by men whose

political and religious views were distasteful to him."[90]

Further to this, one of the leaders of the Royal Society,

John Wilkins, was the brother-in-law to Oliver Cromwell.

Nevertheless, science had become fashionable; which

is to say that it had become highly approved of, and

Charles II's interest in chemistry and navigation

prevailed. It is noteworthy that here, the use of the word 'fashionable' in no way refers to *all* of society; rather, 'fashionable' activitites can, at this time, only be considered to include the upper echelons: i.e. the aristocracy, gentry, and upper-middle-class.

In order to somewhat pacify Charles because of the political and religious disagreements, it was arranged that the King would personally appoint the first President and Council of the Society. As might have been expected, the first President chosen was a Peer, Lord Brouncker, a man whose scientific expertise is not evident. The Council consisted of Robert Moray, Robert Boyle, William Brereton, John Wallis, Timothy Clark, John Wilkins, George Ent, William Aerskin, Jonathan Godard, Cristopher Wren, William Ball(e), Mathew Wren, Thomas Henshaw, Dudley Palmer, Henry Oldenburg, and ? Saville. The first treasurer appointed was William Ball(e).[91]

In the President's address after receiving the Charter, it was claimed that the Royal Society was first; without precedent - "the first foundation of the greatest improvement of Learning and Arts, that they are capable of, and which hath never heretofore been attempted by any."[92] The actual preamble of the

charter, written by Christopher Wren, reads as follows:

> "   And whereas we are informed that
> a competent number of persons of
> eminent learning, ingenuity, and
> honour, concording in their inclina-
> tions and studies towards this employ-
> ment, have for some time accustomed
> themselves to meet weekly and orderly
> to confer about the hidden causes of
> things, with a design to establish
> certain and correct uncertain theories
> in philosophy, and by their labour
> in the disquisition of nature to
> prove themselves real benefactors to
> mankind; and that they have already
> made a considerable progress by divers
> useful and remarkable discoveries,
> inventions and experiments in the
> improvement of Mathematics, Mechanics,
> Astronomy, Navigation, Physics, and
> Chemistry, we have determined to grant
> our Royal favor, patronage and all due
> encouragement to this illustrious
> assembly, and so beneficial and laud-
> able and enterprise.",

while the charter opened with the following statement:

> "   We have long and fully resolved
> with ourselves to extend not only
> the boundaries of Empire but also
> the very arts and sciences. Therefore
> we look with favour upon all forms of
> learning, but with particular grace
> we encourage philosophical studies,
> especially those which by actual
> experiments attempt either to shape
> out a new philosophy or to perfect
> the old. In order therefore that such
> studies which have not hitherto been
> sufficiently brilliant in any part of
> the world may shine conspicuously
> amongst our people and that at length
> the whole world of letters may always
> recognize us not only as the Defender
> of the Faith, but also as the universal
> lover and patron of every kind of truth

> ....know ye that we....have ordained
> ....there shall be a society consist-
> ing of a President, Council and
> Fellows, which shall be called and
> named The Royal Society....The
> Council shall consist of twenty-one
> persons, of whom we will the President
> to be always one....And that all and
> singular other persons who within one
> month....shall be received and admitted
> by the President and Council....shall
> be called and named Fellows of the
> Royal Society, whom, the more eminently
> they are distinguished for the study
> of every kind of learning and good
> letters, the more ardently they desire
> to promote the honour, studies and
> advantage of this society....the more
> we wish them to be especially deemed
> fitting and worthy of being admitted
> into the number of Fellows of the
> same society." [93]

Following this rather promising birth, the activities of the Royal Society led to quite a bit of misunderstanding and ridicule: "even Charles II (is said to have) laughed heartily at its experiments in 'weighing the air'." [94]

On 22 April 1663, the Royal Society received its second Royal charter, and consequently underwent a minor name change - to the Royal Society of London for Improving of Natural Knowledge. This charter invalidated the previous one and established the rules by which the Society still operates. What the Society wanted at this stage in their development was public recognition and security for the futrue. Both of these were necessary

if they had any hope of attaining reasonable success with their work. To this end, as the members well knew, could a Royal charter be of assistance; bestowing two kinds of benefit which would enormously strengthen their position -social prestige and legal standing.

Both the Great Plague and the Fire of London caused the Society to move its meeting-place in 1666 to Arundel House off the Strand, and to the Crowne Tavern behind the Exchange. By the 1670s, meetings were taking place at Garaway's Coffee-House in Cornhill.

In 1675, as further evidence of Charles II's continued support for the Royal Society and his interest in navigation and astronomy, the Royal Observatory was built at Greenwich.

Three years earlier, the Lucasian Professor of Mathematics at Cambridge University was elected a Fellow. His name was Isaac Newton. Newton's influence on scientific method was admirable, for he established (largely with his *Principia Mathematica* [1687] which he dedicated to the Society) what is essentially the method used today. Indeed, his success was widely known. A poem of the day states that: 'Nature and

Nature's law lay hid in night: God said 'Let Newton
Be!' and all was Light'.[95] However, his influence on
the aims of the other Fellows was something close to
mutinous.

Up to this point, the leadership of the Society
maintained a policy directed at projects of utility.
Certainly as late as 1691, with Robert Boyle's last
Will and testament, can the importance of practicality
and Puritanism still be seen. One passage reads as
follows:

> "Wishing [the Fellows of the Royal
> Society] a happy success in their
> laudable Attempts, to discover the
> true Nature of all the Work of God;
> and praying that they and all other
> Seachers into Physical Truths, may
> Cordially refer to their Attainments
> to the Glory of the Great Author of
> Nature, and to the Comfort of
> Mankind." [96]

However, during Newton's reign as President of the
Royal Society from 1703 until his death in 1727, his
authority ran totally counter to the policies of those
before him. His emphasis was strictly non-utilitarian
and he in no way encouraged those who were interested
in invention. Indeed, as Dr. John Arbuthnot (physician
to Queen Anne and famous mathematician and satirist)
was to say "the [Royal] Society under Newton's
presidency for twenty-five years became, like Augustan

society, something of a Whig preserve." [97]

Undoubtedly, the first great creative period of English science was over; although this was a general phenomenon which was not confined solely to England, nor was it attributable solely to the retrograde tendencies of Newton. Hence, the Royal Society came to a standstill, and no longer represented the group of adventurers on the brink of discovery. Instead, it turned into a club of high-class amateurs, nursing their distinctions and socializing with the nobility. The Society had become a Club for peers and dilettanti.

With real science more-or-less at a standstill, and with the continued patronage of the aristocracy, formal education slowly began to acknowledge the existence of science as a valuable subject rather than as a 'Black Art'. As a result of the attacks against the scholastic learning of Oxford and Cambridge, and facilitated by the professorships created by Oliver Cromwell for the Gresham Philosophers (which still existed and were still held by men with progressive beliefs in science), both universities were, by 1700, offering courses in scientific subjects. Dr. John Keil, at Hart Hall, Oxford, was the first to teach natural philosophy in a mathematical manner and with the assistance of

demonstrations and experiments; and by 1704, Oxford
had established a Readership in Chemistry.

However, while these represent the first meagre
attempts at establishing science in the formal curriculum,
much greater results were being obtained from informal
efforts. As early as the 1660s and 1670s, both Robert
Boyle and his assistant, Peter Sthael of Strasburg,
were lecturing at Oxford and Chemistry on chemistry and
natural philosophy. So succesful were these lectures,
that they caused the professor of Greek at Cambridge,
Isaac Barrow, to lament in 1663 that "I sit lonesome as
an Attic Owl, who has been thrust out of the companion-
ship of all other birds; while classes in Natural
Philosophy are full."[98]

Nonetheless, science, as an educational activity,
was to remain largely an untapped resource until well
into the nineteenth century. As J.D. Bernal states,
"science came late into the educational scheme....The
great developments of seventeenth and eighteenth
century science took place not because of, but in spite
of, the place science occupied in education. All the
great scientists up to the middle of the nineteenth
century were self-taught in so far as their science
went, and in spite of the precedent of Boyle....science

did not take root in the older universities. At the end

of the eighteenth century the only educational

establishments which gave anything like an adequate

training in science were the dissenting academies.

In this connection, it is interesting to note that

the idea of a London University was very much alive in

the eighteenth century. On 31 March 1742, the following

announcement was published:

> 'At the East End of Exeter Change
> in the Strand, this evening at six
> o'clock will be opened the London
> University, where all liberal Arts
> and Sciences will be most usefully,
> critically, and demonstratively
> taught in the mother tongue in
> proper courses of lectures, composed
> by men of the greatest learning
> and delivered with good address,
> so as to be entertaining to all,
> and particularly improving to the
> ladies and such gentlemen as have
> not had an academical education,
> as more real learning will be
> exhibited thus in a few months
> than in an equal number of years
> elsewhere.' 99

The Philosophical Transactions

The Royal Society had no government grant, and it

was, therefore, always in financial difficulties. An

inquiry in 1740 revealed that a large number of Fellows

had ceased to pay their subscriptions. One way to make the scientific work pay for itself was to publish a series of reports, and to make these the property of the secretary. In this way, the secratary's salary was met by the printing and selling of the Society's *Philosophical Transaction* which first appeared in 1665. As Bronowski and Mazlish indicate, this practice undoubtedly reflects a strong sense of Puritan independence which marked the first Fellows of the Royal Society - a conviction that success must be earned, and earned as money.[100]

The *Philosophical Transaction* themselves provide an excellent source through which to examine the activities of the Royal Society; and to this end, Robert Merton has performed a most helpful task. In a breaksown of the approximate degree of social and economic influences upon the selection of scientific problems by members of the Royal Society (which is presented here in the attached Appendix), Merton indicates a noticeable shift from projects related to socio-economic needs to projects of pure science. In 1662, 69% of the projects were technologically determined as compared with 46.8% in 1687. This reflects an increase in pure science of 31% in 1662 to 53.2% in 1687.

This shift is even more dramatically portrayed in Merton's analysis of the *Philosophical Transactions* from 1665 to 1702, where it is indicated that, throughout this period, the physical sciences (which - for Merton - includes astronomy, physics, chemistry, and technology) dominate the published reports with an arithmatic mean of 33.8. This compares with the second place biological sciences (biology, botany, and zoology) which totals an arithmatic mean of 18.0. Overall, the most consistent interest is in astronomy; however, by 1702, all of the physical sciences are shown to have given way to the biological sciences, physical anthropology (anatomy and physiology) and medicine.

In an analysis of the *Philosophical Transactions* from 1665 to 1676 performed by myself, it was found that though results varied slightly from those obtained by Robert Merton, both sets of findings were very close and revealed the same tendencies. For example, while Merton's figures for the physical sciences in 1665-67 are 40.8, I arrive at an arithmatic mean of 38.88. Again, while the same figure for 1674-76 is 43.9, my computations are at a figure of 44.4. While my analysis was not conducted under the strictest of circumctances, they were not intended to call into question any of

Robert Merton's conclusions. Rather, they were intended
merely to (asthey, in fact, do) further illustrate and
support the results of Merton's analysis regarding the
shift of interest within the Royal Society.[101]

One remarkable aspects of the articles published
in the *Transactions* is the singular lack of criticism.
Although this is not explicated by Martha Ornstein
(Bronfenbrenner), she states that "we must not forget
that, after all, the majority of the members were not
men of scientific distinction" and therefore, presumably,
cannot be reasonably expected to have been capable of
anything approaching valid scientific criticism.[102]

The basic format of the *Transactions* remains, even
to present day, unchanged. As Charles Babbage states,
"the volumes contain merely those papers communicated
to the Society in the preceeding year which the Council
have selected for printing, a meteorological register,
and a notice of the award of the annual models."[103]

Membership

Perhaps the single most widespread complaint
regarding the Royal Society of London, is that it
became simply an honourific society without any real

regard for scientific and technological problems. And
it appears that this complaint is well founded and lies
rooted in the nature of its membership.

While it is true that the Royal Society included
among its membership the most prominent manufacturers
in England, it is also true that these individuals
joined (as a rule) long after their reputations had
been made and saw the Society as a sort of retirement
club (as did Erasmus Darwin and Josiah Wedgewood). The
fact is that while the provincial associations were
becoming increasingly practical, the Royal Society was
becoming increasingly remote; with the result that the
new discoveries on which the Industrial Revolution was
based were made by men outside the Royal Society
membership. As Richard Awkwright was to say:

> "It is well known that the most
> useful discoveries that have been
> made in every branch of art and
> manufactures have not been made
> by speculative philosophers in
> their closets, but by ingenious
> mechanics, conversant in the
> practices in use in their time,
> and practically acquainted with
> the subject matter of the
> discoveries." [104]

The issue of whether the Royal Society should
continue to tolerate the admission of amateurs or
whether it should become an organization of professional

scientists became somewhat clouded as, well into the eighteenth century, there still existed no clear distinction between profession and trade. In short, the 'scientist' (a term that was to be first used by the British Association for the Advancement of Science in the nineteenth century) had not yet become clearly defined or accepted as a professional who committed his full-time attention to his scientific activity. Science was often still seen as a leisure activity for curiousity seekers. This debate was visible as early as 1699 when, in a poem by the physician, Sir Samuel Garth, he laments:

> "How sick'ning Physics hangs
> her pensive head,
> And what was once a Science,
> now's a Trade."   105

As early as 1674, a council was formed to look into the possibility of ejecting useless Fellows. This council included William Petty, John Lowther, John Cutter, Christopher Wren, Paul Neale, and Henry Oldenburgh; for as early as 1662, Peers were admitted to the Fellowships without scrutiny, and the door was opened wide to gentlemanly amateurs. Indeed, its seems that admission procedures were stacked against those of any real scientific knowledge. According to Charles Babbage, in

order to become a Fellow of the Royal Society, three
signatures from Fellows were required stating that the
individual is desirous of becoming a member, and is
likely to be a useful and valuable one. "This is handed
to the Secretary, and is suspended in the meeting room.
At the end of ten weeks, if [the individual] has the
good fortune to be perfectly unknown by any literary
or scientific achievement, however small, he is quite
sure of being elected as a member of course. If on the
other hand, he has unfortunately written on any subject
connected with science, or is supposed to be acquainted
with any branch of it, the members begin to inquire
what he has done to deserve the honour; and unless he
has powerful friends, he has a fair chance of being
black-balled."[106]

Babbage's claim can be partially substantiated if
one compares the membership of the Royal Society in
1680 with that of 1730, one can see a dramatic decline
in men with strong scientific interests, and an
increase in dilettantes and gentlemen interested in
curiosities. This trend continued so that in the
period from 1820 to 1860, less than 30% of the Fellows
were men of science. It was in these circumstances
that Charles Babbage and a group of young scientists

complained bitterly about the easy admission policies which cluttered the memebrship roles with non-productive individuals who used their membership for personal advantage, and about the lack of practical activity within the Society, that led them to form the British Association for the Advancement of Science in 1831.

The chief defect of the Royal Society, from the point of view of growing technology and industrialization, was its apparent lack of sustained interest in applied science. This was only a natural consequence of equipping itself with members who were incapable of dealing effectively with problems of technical practicality. As the aristocratic and middle-class cultures were supposed to be the most fertile seedbeds of rationalist principles, the Royal Society, while catering specifically to the aristocratic and middle-class, became the institutional embodiment of the 'gentle-amateur tradition'.

Progressively from the early eighteenth century, the Royal Society became little more than a fashionable debating society, which promoted or conducted little or no research. In England at this time, science was pursued by no powerful profession; and the curiousity, the thirst for knowledge, and for rational explanation which had motivated the founders of the Royal Society

was no longer evident in the aristocratic and middle-class cultures. This had begun to seep down into the lower orders of society, and thus, a new calibre of man had been passed the scientific ideology.[107]

Summary

In examining the development, activities, and publications of the Royal Society of London, it is clear that there occurred a shift from a *science-based* ideology, which was evident in the Baconian vision, and the Gresham College Philosophers, to a *class-specific* ideology in the Society itself. In neglecting to maintain a highly qualified membership, the once-prestigious group became nothing more than a fashionable club specifically designed for aristocrats and the upper-middle-class. Within this association, although no real research was carried out, the scientific facade and terminology were rigidly maintained; and indeed, became central to the value system of the members.

The scientized activities (i.e. the journal, the meetings) operated as an internal justification mechanism;and this, plus the social status (see

Appendix A) of the members was sufficient to give the external *appearance* of a prestigious scientific association.

Thus, in operating with terminology and activities which were essentailly emptied of any real scientific meaning, the practices of the Royal Society can be seen as approaching a scientism; although in no way near the extent of that experienced in the lower- and working-classes in the nineteenth century. Nevertheless, as the logic of science, technology, and education are determined by class-interest, the unqualified but prestigious membership of the Royal Society of London can be seen, not as applying *scientific* principles to the industrial processes which they controlled, but rather, as applying *scientized* principles to their perceptions of Nature and society. In either case, this meant domination, and the maintenance of their superior social position.

IV

PROVINCIAL CULTURE AND SCIENTIFIC ASSOCIATIONS:
THE PROVINCIAL SOCIETIES AND THE ROYAL INSTITUTION

In the period from approximately 1760 to 1851, it
was in the rapidly expanding urban centers, such as
Manchester and Birmingham, that the alliance between
science and technology was to develop most strongly.
And it was likewise in these centers that the perspective
of scientific attention was to change; from an interest
in astronomy - as was illustrated by the Royal Society
and the gentleman-amateurs - to a concern for physics
and chemistry. Or, to put it differently, from the
science of mercantile society to that of industrial
society. In this development, the influence of the
Midlands, and of Scotland, was to be central.

This area was increasingly middle-class and non -
conformist; and reports suggest that upwards of thirty
per cent of the population were Dissenters. Of this
group, as Hurwich states, Dissent was even more
prevalent in the merchant oligarchy than in the general
population.[108]

Broadly speaking, dissenters (who included

Congregationalists, Baptists, Presbyterians, and
Unitarians; but not Wesleyan Methodists, for they did
not, technically speaking, dissent from the formalities,
teaching, and discipline of the Church of England), were
the most industrious group in the population; and they
carried this industriousness into the study of science.
One indication of the scope and vigour with which the
new urban centers approached science was that while,
at one time, the Royal Society had represented the sole
representation of institutionalized scientific pursuit,
now (post-1760) the scene was crowded beyond recognition,
with scientific and technological interest in the
northern urban centers approaching a near mania. By
the late eighteenth century, at least 16 provincial
societies covered the whole of science, while more than
two dozen other provincial associations singled
specific disciplines.

This development was crucial, as Morris Berman
has indicated, for it represented for these middle-
class dissenters the emergence of a concrete alternative.
"If the landowners had their day vis-a-vis science, the
opportunity was ripe for other classes to begin
defining it in accordance with *their* special goals."[109]

Most of these early scientists, technologists,
and industrialists were Puritans by birth, and came
from merchant and small-holding families. However
intellectually, their Puritanism gave them a special
alignment for their materialist and deist concerns
as well as a noted indifference to the traditional
authority systems. Both of these characteristics may
be broadly summarized by the word 'non-conformist'.
What gave provincial intellectual life its particular
vigour was the interest in change. This interest was
extended over a spectrum of social activity and was
inspired by the Baconian/Comenian belief system
which called for the merger of knowledge and utility.
That is, that learning should be put to social use.

Based largely upon the system of education
advocated by John Amos Comenius, the Puritan movement
for educational reform emphasized empiricism and
utiliatrianism. In such a system, science and religion
proved to be natural partners for both placed a great
emphesis on the 'natural order of things', which
Newton (a conformist) had clearly illustrated. This
concern with the natural order or natural virtue
perhaps reached its peak with the English radicals
and Dissenters, as there occured, between 1760 and .

1790, an 'outbreak' of Rousseaumania which was fueled
by the publication of Rousseau's *Emile* (1762). As we
shall see, some of the Rousseaumaniacs met with
disasterous, or otherwise unsatisfactory, results.

The unusally high visibility of Dissenters in the
provinces, and especially Birmingham, is due to their
forced concentration by specific legislation which was
designed to discourage and isolate them. Two specific
codes which were devised to eliminate dissenting
political power were the Corporation Act of 1661 and
the Oxford or Five-Mile Act of 1665.

The Corporation Act required all municipal office
holders to take the Oath of Allegiance and Supremacy,
and an oath of non-resistance to the King. Obviously,
if a Dissenter was to do so would require the
denounciation of his faith. The Five-Mile Act was
more carefully aimed and explicitly forbade any
non-conformist ministers to preach in any corporate
town. Thus, the goal of the Five-Mile Act was to
compell the non-conformists to live away from the
corporate cities; and thus, away from industry, money,
and politics. In general, the strategy of these codes
was to prevent the spread of Dissent, however, these
legislations lost their power in centers such as

Birmingham, which was not a Chartered Borough, and
therefore, became a haven for Dissenters.

The Act of Uniformity provided that 'Every
schoolmaster.....should subscribe a declaration that
he would conform to the liturgy as by law established
and should obtain a license permitting him to teach
from his archbishop, bishop, or ordinary of the
diocese'[110]; and thus excluded Dissenters from entering
the established universities. As a cumulative result
of this, and other oppressive Acts, the Dissenting
Academies emerged.

These academies offered for the first time a
formal education which was practical and directed
towards the needs of commerce and industry. A typical
curriculum at such schools included mathematics,
natural science, logic, rhetoric, metaphysics, ethics,
geography, history, anatomy, and hebrew; and most
academies offered a five-year course for those
intending ministers, and a three-year course for
those proposing to enter one of the professions,
commerce, or industry. By the end of the eighteenth
century, the Dissenting Academies (next to the
University of Glasgow and of Edinburgh) provided the
best scientific education available in the world.

For this group of middle-class, dissenting, industrialists, science took on an identity forming function. While the landed aristocracy had used science to further their social isolation, the middle class provincials used science socially as a cultural legitimiser. The period from 1790 to 1851 saw the sciences, in cultural terms, popularized by a relatively small social group who, at times, propelled towards a mass audience.

It has been argued (i.e. by Ian Inkster[111]) that in Britain by mid-nineteenth century there emerged a particular version of high-culture developed by a national elite for whom 'culture' meant what the lower and (even more) the working classes lacked. To this group, the attraction of science was a direct reflection of its perceived utility. As a tool for social legitimation, there can be no doubt that science proved to be eminently appropriate, and provided an alternative cultural form to those directed by the more traditionally dominant social groups.

This change in the English intellectual climate was a reflection of the growing definition of the cultural value system which was being developed by the new middle-class — the owners of the modes of

production. This emerging science-based ideology
revealed two distinct tracks. On the one hand, the
specialization of scientific knowledge, which was to
be an essential feature of the normal science of the
mid- and later nineteenth century, was promoted by its
adoption by the experts and its consequent presentation
as 'expertise'. On the other hand, a more 'popular'
version of science began it slow filtration process
down through the urban working-class.

By this time the commercial and industrial middle-
class had become increasingly stratified, or internally
ranked in order of success; and given their social
isolation as Dissenters, and their increasing wealth,
the group elites sought out the amenities of civilized
life. As a direct consequence of their now highly visible
importance in industry and the national good, further
power and attention began to accrue to them. For example,
as Robert Schofield states, "a significant change is
observable in the attitude of the professional classes.
Naturally sensitive to economic changes because of
their economic dependence upon the dominant social
groups, it is not suprising that in spite of the
supposedly superior status conferred [on them] by
alliance with the landed aristocracy, they rapidly

shifted their connection and their support to the
industrialists." [112]

Contrary to an oft publicized viewpoint, science
(during the first half of the eighteenth century) did
not die; indeed, it flourished. However, it did so in
different circles than it had previously, and succeeded
in spite of the fact that it was rarely encouraged by
the higher social ranks or government, where there was
a growing conservatism and increased veneration for
what existed. One of the most characteristic developments
of the eighteenth century was the proliferation of
provincial scientific societies; and these associations
greatly reduced the intellectual importance of London.
In considering this development, it is inappropriate
to adopt a simple causal-theory of middle-class
determinism; more realistically, the flurry of
scientific activity and organization in the industrial
districts was a reaction to circumstances rather than
a deliberate attempt to shape them.

Including the prominent manufacturers, such
societies - though small - had administrative
flexibility which made them adaptable to the intellectual
needs of the members. While both specialist and generalist
scientific societies arose, science was often not the

sole topic of concern. With the French Revolution and the American fight for independence, discussion often turned to politics and civic affairs. This was especially true in the provinces where the members were generally radical and liberal.

As science had not yet been split by nineteenth century academicism into a superior 'pure' and an inferior 'applied' branch, the advancement, dissemination, and application of science to industrial production remained the main link between these scientific associations.

Outside the Dissenting Academies, the now national interest in the industrial applications of science stimulated little formal educational provisions before 1823. Until that time, education was to remain decreasingly possessed by the Church and the State.[113]

The Lunar Society of Birmingham

Throughout all of provincial industrial and scientific society, nowhere is the interest in science and technology more intense or more purposeful than in the Lunar Society of Birmingham. [114] The suggestion has frequently been made that this association was

characteristic of its time, differing from other societies only in the extraordinary quality of its limited membership. Over the years, a total of only fourteen certified members of this 'industrial research organization' have been identified: these include Matthew Boulton, Erasmus Darwin, Thomas Day, Richard Lovell Edgeworth, Samuel Galton Jr., Robert Augustus Johnson, James Keir, Joseph Priestly, William Small, Jonathan Stokes, James Watt, Josiah Wedgewood, John Whitehurst, and William Withering.

This society was a very informal group of friends who had a shared a very broad interest in science and its industrial applications. The outlook of the members, as was commonly found among the industrialists of the area, was fresh, innovative, and receptive. As the 'lunatics' slowly eveolved into a semi-formal, barely organized group, they also became the unofficial focus and clearing house for scientific activity outside their membership.

It was not until approximately 1775 - 1780 that a real 'Lunar Society' can be spoken of. The first appearance of the name 'Lunar' occurs only in 1776; and until that time, the members were nebulously known as the Birmingham Philosophers. As a more recognizable

association (although they never recorded minutes or published preceedings), the Lunatics met at the homes of members for dinner and discussion in the afternoon on the Monday closest to the full moon - hence the name 'Lunar'. This was done so that, in the absence of street lighting, the paths home at night would be visible..

Dr. Priestly knew well the advantages of being associated with this illustrious group as "it was not every scientist who [could] rely upon his friends to supply him with crucibles, test-tubes, flasks, and the hundred and one small things of everyday use in the laboratory";[115] and it was he who first published a reference to the Lunar Society. In Volume Two of his *Experiments and Observations Relating To Various Branches of Natural Philosophy* (1779), Priestly states that "With me it was a mere random experiment, made to entertain a few philosophical friends, who had formed themselves into a private society, of which they had done me the honour to make me a member."[116]

The extremely wide range of interests which the Lunar Society actively pursued can be imagined by looking at the fields where they specifically had profound effect. An incomplete listing of their

developments would have to include steam power, turn-
pikes, canals, carriages, mechanical telegraph, banking
and credit, coining-press, coal-gas illumination, time-
clocks, mineral resources, mining, metalurgy, chemicals,
food supply and distribution, health, sanitation,
agriculture, hospitals, clinics, museums, libraries,
tableware, plumbing, politics, economics, public
education, astronomy, optics, textiles, and smelting
processes. In all of these fields, members of the Lunar
Society, either individualually or collectively, *directly*
affected these major developments of the Industrial
Revolution. During their period of activity, the
number of patents awarded to residents of Birmingham
was triple that of their nearest competitor - Manchester
(See Appendix D).

"To [the Lunar Society] the current interest in
science was unmistakeably economically purposeful. Its
purpose was 'to glut [Britain's] rage commercial'. In
Birmingham, 'that town, the mart of rich inventive
Commercial', it was 'Science' which, in Anne Seward's
words, 'Leads her enlightened sons to.....Plan the vast
engine.'" As Neil McKendrick has stated, "they did not
envisage defeat. Science and industry would march in
triumphant unison towards the solution of all the

world's problems - social, political, and material.
Joseph Priestly was voicing no lonely belief in the
practical objectives and future achievements of science
when he wrote in 1768 in his *Essay Upon The First Principles
of Government* that: 'Nature, including both its materials
and its laws, will be more at our command; men will
make their situation in the world absolutely more easy
and comfortable; they will probably prolong their
existence in it and will daily grow more happy.'"[117]
It was also in this tract that, in the first years of
the nineteenth century, Jeremy Bentham would find the
core of his philosophy - 'the greatest happiness for
the greatest number'.

From this bourgeois group of Midland scientists,
manufacturers, merchants, and industrialists, science
and its application was to receive a remarkable
enthusiasm and seriousness of purpose. They passionately
believed in the benefits of industry, commerce, and
experiment. They passionately believed in progress. In
his own way, Matthew Boulton was to phrase it well. In
a letter to Empress Catherine of Russia, he said:""I
sell what the whole world wants - power."[118] The Lunar
Society was not a group who stumbled blindly onto
invention by chance. Each step was a calculated

reaction, a reasoned activity; and their scientific work, and the subsequent economic success, only served to strengthen their developing science-based ideological attitude. [119]

The Lunar Society and Education

From their core interests in the advancement of science and technology, the members of the Lunar Society diversified; moving into areas of wider social and political questions, not the least of which was education. In this field, the Lunatics were not so much pioneers as they were responding to a general social awakening as to the benefits of education. As James Keir wrote in his *Dictionary of Chemistry* (1789): "The diffusion of general knowledge, and of a taste for science, over all classes of men, in every nation of Europe, or of European origin, seems to be a characteristic feature of the present day.

Percival, Priestly, Boulton, Watt, Galton, and Wedgewood all rejected the more traditional methods of instruction, and the traditional institutions when it came to the education of their own children. Certainly, it may well have been this necessary attention to their

own families which first prompted an interest in educational ideas and methods. Like most educational innovators, Priestly, Edgeworth, and Day, in particular, were especially interested in methods of instruction which would secure the pupil's active participation.

Their ideas were first drawn to various conceptions of the moral qualities which may be desireous to inculcate - on the type of people education should produce. For them, the next possibility for shaping the minds of young people was to come through Hartlean Associationism.

David Hartley's (1705 - 1757) approach to psychology, which was not exactly scientific, claimed to use the methods of Isaac Newton as explicated in his *Theory of Attraction*, and Hartley claimed that the approaches to physics were entirely appropriate to, what we would call, the social sciences.[120] Through Hartlean Associationism, the learning process was seen as a rational process, and this led to speculation that education itself would someday become a science.

These ideas were not to remain in isolation as some were put into practice at the Warrington and Manchester Academies, where Priestly and Wedgewood

lecturers and alumni. During the decade he was in
Birmingham, Priestly, being a Dissenting minister,
preached, instructed children in religion, and edited
a theological periodical and helped organize one of
England's first Sunday Schools. Not a typical Sunday
School, this school was designed for the working-classes;
offering instruction to the children in reading and
writing, and offering the adults classes in mechanics.

Matthew Boulton and James Watt shared Richard
Edgeworth's concern for practicality. Following Maria
and Richard Edgeworth's phrase in *Practical Education* (1798),
'Education practical, never ends!'[121], both Boulton
and Watt directed the education of their sons towards
their pre-determined future roles in the further
development of science and industry; stressing only
skills such as economy and good writing. Emphasis was
also placed on conic construction and geometry, algebra,
trigonometry, the use of logarithms, and ratios. In a
letter dated 1777 to Matthew Boulton is revealed the
very distinct views about the sort of education which
was required by boys who were to become gentlemen,
manufacturers, and philosophers. The letter, from
Mr. Pickering, advises that Boulton's son be transferred
from being a day boy at a local academy to a parlour

boarder for, as a day pupil, he would 'necessarily acquire a vicious pronunciation and vulgar dialect.'[122]

Richard Edgeworth had a large family of twenty-two children by four marriages, and living in extremely rural settings, was the only Lunatic to be included in the membership by correspondence. His geographical isolation, therefore, required that the children be educated at home, and that he work out any educational problems for himself.

The theory which evolved in this process was elaborated in two books - *Practical Education* and *Professional Education* (1809). Both of these books contain valuable ideas, and the first of them, according to Alice Paterson, constituted "....the most important work on general pedagogy to appear in [England] between the publication of Locke's *Thoughts* in 1693 and that of Herbert Spencer's *Essay on Education* in 1861."[123]

Two of the best known educational failures which are attributable to Rousseaumania are those claimed by Edgeworth and by Thomas Day. Many of the other Lunatics became directly involved in education either through publications, or by assisting in the founding of schools. These included Darwin who, in 1797, wrote *A Plan for the Conduct of Female Education*. Along more informal lines, a young machinist at the University of Edinburgh, named James Watt,

used his shop as a meeting place for professors and students. Indeed, being a self-made man (as he often claimed), it was at these meetings that he acquired most of his scientific education.

Both Wedgewood and Darwin either gave or encouraged public lectures. For example, as was reported in *Aris's Birmingham Gazette* on 23 October 1762:

> "The body of the Malefactor, who is order'd to be executed at Lichfield on Monday the 25th instant, will be afterwards conveyed to the house of Dr. Darwin, who will begin a Course of Anatomical Lectures, at Four o'clock on Tuesday evening, and continue them as long as the body can be preserved, and shall be glad to be favoured with the Company of any who profess Medicine or Surgery, or whom the Love of Science may induce." [124]

The Lunar Society, the Provinces, and Politics

In the last quarter of the eighteenth century, there were increasing signs that the manufacturers of England had come to recognize a sommon set of basic interests. This is evidenced by the organization, in 1785, of the General Chamber of Manufactures; and indicates the realization that the manufacturers were

a substantial political force in the community. This
interest in politics certainly did not escape the
interest of the Lunar Society.

During the period of the American Revolution, and
later, the French Revolution, there was much political
discussion, agreement and disagreement, both within the
group and in the public generally. Wedgewood, like
Priestly, was a Whig, a Dissenter, and a supporter of
both Revolutions; and thought that religion and politics
should be subject to the rational process. Meanwhile,
in a poem by John Bicknell entitled *The Dying Negro*,
Thomas Day (who had been called to the Bar in 1775, and
consequently involved in the political excitement of
the time) is aligned with the anti-slave movement.

However, the Revolution which really caused a
popular reaction was the French. To those watching from
England, the French Revolution symbolized a real shift
in class power. This symbolism, plus the rapid alterations
to English life caused by the Industrial Revolution,
merged and resulted in a renewed sense of social
direction for some social classes. For example, as
Morris Berman has pointed out, "the French Revolution
generated an interest in education organizations for
the poor as a means of instilling appropriate political

attitudes, while the Industrial Revolution provided
a definition of science that seemed quite applicable
to the relief of....distress."[125]

The French Revolution also was responsible for
very strong social tensions within England. Opinion
was hardening against the Revolution, and merely to
disagree publically with the Church of England or the
law was considered tantamount to rebellion, if
not treason. It was the sentiment of numerous judges
that "to touch anything of the ancient fabric of laws
was an invitation to revolutionary sentiment: things
were to be left exactly as they were."[126]

It was this sort of sentiment, converted into
angry activity, which was to mark the effective end
of the Lunar Society of Birmingham. Although Joseph
Priestly was not actively political, he did help
organize the Revolutionary Society in Birmingham in
1788-1789 in support, and in honour of the Glorious
Revolution of 1688 and its principles. On 14 July 1791,
this group held a dinner commemorating Bastille Day.
And although Priestly did not attend, the dinner
sparked off a riot during which the mob destroyed
Priestly's church, home, laboratory, and library. In
the two days that followed, and amidst cries of 'No

Philosopher!' and 'Church and King Forever!', the
crowd destroyed the houses of as many of the 'damned
Presbyterians' as they could find. In a letter written
by George III to Dundas, he said that "he could not
but feel pleased that Priestly was the sufferer of
the doctrines 'he and his party have instilled'."[127]

Priestly, being thus permanently forced from
Birmingham, and later to go to America, was to write:

> ."I consider my settlement at
> Birmingham as the happiest
> event in my life, being highly
> favourable at every object I
> had in view, philosophical or
> theological....I had....the
> society of persons eminent for
> their knowledge of chemistry,
> particularly Mr. Watt., Mr.
> Kier, and Dr. Withering. These
> with Mr. Boulton, Dr. Darwin,
> ....Mr. Galton, and afterwards
> Mr. Johnson of Kenilworth, and
> myself dined together every
> month, calling ourselves the
> lunar society, because the
> time of our meeting was near
> the full moon." [128]

At the suggestion of the majority of the members
of the Philosophical Society at Derby, the following
communique was issued on 03 September 1791:

> AN ADDRESS TO DR. JOSEPH PRIESTLY

> Sir;
>   We condole with yourself and
> with the scientific world on the
> loss of your valuable library,
> your experimental apparatus, and

> your more valuable manuscripts:
> at the same time we beg leave to
> congradulate you on your personal
> safety in having escaped the
> sacrilegious hands of the savages
> at Birmingham.
>
> R. Roe,
> Secretary" 129.

While Robert Schofield claims dubiously that the
Lunar Society was a pilot project or advance guard of
the Industrial Revolution, the Society did, more than
any other single group, represent in brilliant
microcosm, the dynamic forces of change in eighteenth
century England.[130]

The Literary and Philsophical Societies

The Literary and Philosophical Societies which
began to appear in England at the end of the eighteenth
century served the intellectual and educational needs
of the middle- and upper-classes. By 'Philosophical'
is meanth 'Scientific' (i.e. natural philosophy); and
the adult classes in science which were a part of the
activities of these associations were designed more
for social purposes than utilitarian purposes. As Ian
Inkster has stated, "the individuals and families

central to the life of the Manchester Literary and Philosophical Society almost epitomized the wealth, occupational, and social structure of the city. Within Manchester, the group appears to have been socially dominant."[131]

These societies were largely meeting places for the elites and were not open to mechanics and artisans. However, this was not always the case. As Roderick and Stephens state with regard to the Scarborough Literary and Philosophical Society (1827): "In 1834, for example, the members of the Scarborough Mechanics' Institute were invited to view the Society's Museum, and 'the council had much pleasure in affording an intellectual feast, without sacrifice on their part, to the members of a kindred, though somewhat humbler institution. Every endeavour to raise the character of this class of society tends to the furtherance of science and the development of genius, as a very large proportion of the most active scientific labourers have arisen from the humbler ranks of life'."[132]

Like the Royal Academy of Arts, the Manchester 'Lit. & Phil.' was, at least nominally, devoted exclusively to cultural aims and technical progress. Organized officially of 28 February 1781, its aims

from the first included the application of science to
mechanical improvement. Although the main tools to aid
adult education in these societies were the libraries
and museums (both of which were very strong in Manchester),
Manchester's contribution in this area was very important.
Not only were lectures and debates offered, but in 1783
the Manchester 'Lit. & Phil.' organized a mechanics'
school called the Manchester College of Arts and
Sciences. At the College there was not to be merely
an exhibit, nut a laboratory and a superintendant to
give lectures, advice, and assistance.

While not all of the original and more elaborate
features of the College were adopted, the initial plan
remained essentially in tact. However, as was perhaps
to have been expected, this unique and radical proposal
to unite cultural with utilitarian aims was not
entirely approved of by the more conservative members
of the Society, and some members withdrew in protest.

Nevertheless, science was to become the
predominant mode of cultural expression in Manchester.
And the first volume of the *Memoirs of the Manchester
Literary and Philosophical Society* (1785), which was dedicated,
by permission, 'To The King, with peculiar gratitude
for his gracious patronage of the first fruits of this

Institution', stated that:

> "The numerous Societies, for the
> promotion of Literature and
> Philosophy, which have been formed
> ....have not been only the means
> of diffusing knowledge more
> extensively, but have contributed
> to produce a greater number of
> important discoveries, than have
> been effected in any other space
> of time."   133

The *Memoirs* go on to say that:

> "It is to the honour of the
> present age, that it has extended
> the empire of Science, and of the
> Arts, so far beyond its ancient
> boundary..,.[and that] it is more
> than any [age] which has preceeded,
> of the immense importance of
> education....Hence, it is, that so
> very few of these young men who
> are destined for trade, enjoy any
> advantage beyond those of a
> grammar school.....It is Granted
> that the examples are too rare,
> of those who have united the
> manners of the Gentleman, the
> taste of the Scholar, and the
> industry of the Tradesman. Yet,
> such examples *have* been seen, and
> nay *still* be among us.
> ....Perhaps, one reason why they
> are so uncommon may have been;
> that those places of education,
> which tend to form the Gentleman,
> and the Scholar, have been
> unfriendly to the habits necessary
> to the Tradesman....Perhaps, the
> happy art mightbe learned, of
> CONNECTING TOGETHER LIBERAL
> SCIENCE AND COMMERCIAL INDUSTRY!
> ....If the scheme appears visionary,
> yet it deserves a trial. It is,
> indeed, as far as I know, NEW..I

> have never heard of a similar
> establishment....Such a school
> would probably lecture natural
> philosophy, les Belles Lettres,
> mathematics, history, law,
> commerce, and ethics." 134

In view of the foregoing, it is interesting that
the College of Arts and Sciences (which is not to be
confused with the Manchester Academy or 'New College' -
forerunner of the modern Manchester College - Oxford
which was founded by by Dissenters on 22 February, and
opened on 14 September 1786 as an attempt to save
something from the wreckage of the Warrington Academy)
which started with such high hopes, had only a brief
existence, lasting only until 1787-88. As Musson and
Robinson explicate, "the causes of the College's
demise are not clear but are said to have included 'a
superstitious dread of the tendency of science to
unfit young men for the ordinary details of business'."
The Manchester Literary and Philosophical Society
itself, however, had a more prolonged life, eventually
becoming   (via Owen's College), the University of
Manchester in 1851. 135

The Derby Philosophical Society

Samuel Smiles said in *Boulton and Watt* (1866) that

the "little coterie [which have been] established all over England of men ready and anxious to discuss the latest scientific discoveries and the most recent improvements were usually centers of the best and most intelligent society of their neighbourhoods, and were for the most part distinguished by an active and liberal spirit of enquiry."[136] In this tradition was the Derby Philosophical Society.

Initiated by Erasmus Darwin, the Society began in 1783, and was formally inaugerated at Darwin's house on 18 July 1784. In his inaugeral address, Darwin made it clear that the 'drawing-room experiments' had a serious scientific purpose and that they, as a group, must continue the search for more "'gentleman-like facts'. - a phrase which Darwin used when asking James Watt for information about his steam engine."[137]

As Susannah Wedgewood had written to her father Josiah in the early days of the Society (13 March 1783) - "the Philosophical Club goes on with great spirit, all the ingenious gentlemen in the town belong to it, they meeting every saturday night at each others houses"[138]; however, with time, the meetings were reduced in frequency to once per month - at 6:00 P.M. at the King's Head, Derby.

Realizing the importance of scientific libraries,

the Derby Society ordered several books and journals on natural philosophy, however, as was occuring in other societies, the members' general reading was coming under the influence of volumes such as Smith's *Wealth of Nations* and Paley's *Moral and Political Principles*.

Although less distinguished than either the Lunar Society or the Manchester Literary and Philosophical Society, the Derby Philosophical Society had its links with both, and helped maintain that spirit of inquiry on which England's industrial and scientific greatness was built. The Society lasted until 1857. [139]

The Royal Institution of Great Britain

During the reign of George III (1760-1820), or 'Farmer George' as he liked to be called, the aristocracy, the clergy, and the politician and industrialist landowners became passionately concerned with the craze for agricultural improvement. Technological progress in agriculture was significamt in this period, and a host of farming societies were established to facilitate the exchange of knowledge and ideas in this field.

Also under the auspices of 'Farmer George', 75% of

all the enclosure acts ever passed by Parliament were proposed and enacted; and the Board of Agriculture was formed in 1793 to "spread the zeal for enclosure and improvement among the landowning classes."[140]

As a result of the social tension and the fear of revolution which existed at the time, the Society for Bettering the Conditions of the Poor (SBCP) was formed in 1796. Its goal was shared by the Board of Agriculture, and the two organizations shared their most active members. However, both the Board and theSBCP failed to interest the aristocracy in improvement and enclosure allotment to the poor. Thus, the group of innovative landowners remained small.

The Baconian vision of the marriage of science to industry which had been submerged in conservative circles since the early days of the Royal Society, was now - in the late eighteenth century - making a dramatic comeback. The entrepreneurial and scientistic ideology which was now nationally visible was continuing to become refined and precise; and consequently, was steadily becoming an attractive alternative to the traditional order. "What the Baconian vision really required to become a truly legitimate rival to the older ideology was support on the part of the very

class with which the dilettanti tradition was invariably associated. There had to be, in short, a departure within the ruling class itself from traditional notions."[141]

In 1796, with his *An Account of the Establishment for the Poor at Munich together with a Detail of Various Public Measures connected with the Institution*, Benjamin Thompson (Count Rumford) revealed his interest for the 'sturdy beggar' and made a personal contribution with his lasting innovation of civic financed soup charity. Indeed, this was a problem that all of Europe was recognizing; given the state of technology and industry, even the leading countries were unable (or, until this time, unwilling) to bring the available work and manpower together.

In an article written for the SBCP Reports stated that 'the means of industry' should be directed for the improvement of the poor. "Let us therefore make the inquiry into all that concorns the *poor*, and the promotion of their happiness, a *science*; let us investigate *practically*, and upon *system*, the nature and consequences of those things which experience hath ascertained to be beneficial to the poor.""Much of this was derived from the ideas of Jeremy Bentham,

whose ideology of science came to play a crucial role
at the Royal Institution in years to come."[142]

Consequently, Count Rumford developed a proposal
that would create a relationship between philosophers
and workmen, and which would be directed towards the
improvement of agriculture, manufacture, commerce, and
'the augmentation of domestic comforts'.[143] Morris
Berman states the subsequent events succinctly:

> this Proposal was "circulated
> among the wealthy classes of
> London, and received a quick
> response from fifty-eight of
> Britain's most famous families.
> Some of this group - how many
> is not clear - then met at the
> home of Sir Joseph Banks on 07
> March 1799 to found the
> institution, and elect the
> Committee of Managers (at first
> five men), who had been chosen,
> in advance by the Select
> Committee of the SBCP. On
> March 9th, the Managers assembled
> at Banks' house once more, at
> which time they planned to have
> 500 copies of Rumford's Proposal
> printed, solicit further
> subscriptions, and present a
> copy of the Proposals to George
> III. The King became a patron in
> June, giving the Institution the
> right to call itself 'Royal'. In
> September, [Sir Thomas] Bernard
> arranged the purchase of the
> mansion of a John Mellish at
> 21 Albemarle Street,....and a
> Clerk of the Works, Thomas
> Webster, was engaged. The Royal
> Institution was well on its way."[144]

Indeed, the Institute seems to have begun with a dual emphasis, or objective. On the one hand, Count Rumford, along with Sir Thmas Bernard of the SBCP, envisioned a technical college for artisans in which a "collection of models of fireplaces, grates, stoves, steam-engines, spinning wheels, etc." would be included.[145] Also, a professor would be appointed and provided with a well-equiped lecture room. On the other hand, the majority of members were 'improving landowners' who saw science as an instrument of economic policy, and who were hoping for personal benefits of applied science.

At this time in London, private lectures in natural philosophy were available from professionals in their homes. These individuals were often physicians. At such meetings, groups were small and usually consisted of 'high society'. Their patrons were largely motivated by the ideals of the gentle-amateur-tradition. The early govenors of the Royal Institution recognized the popularity of lectures, and included a programme of lectures in their philanthropic schema. These, plus the publication of a journal, the Model Room, the mechanics' school, and the laboratory, combined to complete the Proposals.

The Institute's first choice of lecturer was
William Farish, the professor of chemistry at Magdelene
College, Cambridge. He was the first in England to
lecture on the application of chemistry to industry.
Being an Evangelical, and thus committed to the causes
of philanthropy, he appeared to be an ideal choice.
However, he declined the invitation.

The second choice for lecturer was the lecturer
at Anderson's Institution in Glasgow - Thomas Garnett.
Trained in Scotland, Garnett was well-known for the
practical nature of his lectures; and on 04 March 1800,
he began a programme of both entertaining and serious
lectures at the Royal Institution.

Despite Garnett's immediate popularity, friction
developed between himself and the managers. The exact
source of this friction is uncertain. Nevertheless, in
1801, the Managers refused a pay increase which was
requested by Garnett; and Humphrey Davy was soon after
engaged as Assistant Lecturer in Chemistry and
Director of the Chemical Laboratory. This escalated
existing tensions between Garnett and Management with
the result that on 01 June, Davy was appointed Lecturer.
Garnett resigned two weeks later.

Davy's lectures also proved popular and were well

attended by members of Londons more fashionable society.
It seems that Davy had a particular ability to make
people feel at ease with science, showing its simplicity,
and thus, making the prospect of becoming a part-time
scientist both an exciting, and a viable, one.

During Davy's tenure, and after Rumford's
departure for the Continent in 1804, the character of
the Institution underwent substantial changes, noteably,
the dropping of the mechanics' school and the increased
concentration on the popular scientific lectures. The
potential for more extravagent lectures was enhanced,
as, by this time, the Royal Institution sported the
leading chemical laboratory in England.

In 1813, Michael Faraday was engaged as Davy's
assistant; and eventually (with Davy's death in 1829)
became the first Fullerton Professor of Chemistry.

From the very beginning of the Institution, the
publication of a journal was undertaken. In an attempt
to convey to a wide audience practical scientific
knowledge, a conscious effort was made to content and
format of the *Philosophical Transactions of the Royal Society*
which reported largely on matters of antiquarian
interest. Rather, the content and form of the SBCP
Reports was seen as being preferable as it was more

of an information sheet containing matters of practical use. However, the journal was unable to escape the Royal Society's influence and articles did appear on natural history and on astronomical observation. However, even after being supervised by Count Rumford, Arthur Young, and Humphrey Davy, the journal succumbed to financial pressures and was discontinued in 1803.

It has been suggested[146] that the survival of the Royal Institution between 1811 and 1840 is attributable to a judicious mixture of amateur and professional elements in the membership. This can be illustrated by the fact that in 1799, 50% of the founding members, and 75% of the first Govenors, could be classified as 'improving landlords' - that is "members of the peerage and wealthy gentry who were in the forefront of agricultural development and estate exploitation."[147] By 1803, only 25% could be so classified. Originally, the overall membership claimed agricultural interests: by the 1830s, only 6% claimed agricultural interest while 60% claimed professional affiliation.[148]

This shift within the Institution also finds correlation with the fact that by the mid-1820s, the leadership was largely Whig and Utilitarian; and, as in the provincial associations, science had become

"both the rationale for expertise and the motto of
a would-be smoothly functioning social order."[149]
Indeed, the Royal Institution shares many characteristics
with the provincial literary and philosophical societies
which became numerous in the 1820s and 1830s. As
Charles Babbage states, "The Royal Institution was
founded for the cultivation of the more popular and
elementary branches of scientific knowledge, and has
risen from the decline of the Royal Society, to a
more prominent station than it would otherwise have
occupied in the science of England. Its general
effects in diffusing knowledge among the more
educated classes of the metropolis, have been, and
continue to be, valuable."[150]

"The gentleman amateur tradition in British science
was, as [Robert] Merton would say, highly 'congruent'
to the world of the landed aristocrat;....[however],
the impact of the [Royal] Institution was to articulate
and consolidate ideologies of science which would
ultimately usurp the aristocratic one."[151] Although
the Royal Institution was both fashionable and elegant,
these were not its goals. The Institution provided,
by its pursuit of entrepreneurial and professional
scientific orientations, an example for the transfer

of national ideologies and power systems.[152]

Summary

As we have seen from the above examination of
provincial scientific associations and the Royal
Institution, the period from approximately 1760 to
1851 is rich in examples of the development of a
science-based ideology.

Throughout this chapter, we have seen the affect
upon social cohesion of differing religious and
political affiliations; and the subsequent development,
within an expanding bourgeoisie, of industrially
oriented social aspirations.

During this period of the enhanced belief in
science, of the increased mis-application of 'scientific
methodology' to social questions (i.e. Hartlean
Associationism; or the poor), and of the continued
application of techniques to all levels of society,
it becomes very clear that science and technology are
no longer seperable from the social apparatus. In this
role, as directed by the middle-classes, the non-
neutrality of a scientific ideology in the domination
of the lower orders is clearly visible. And as

exemplified by the Royal Institution, the national exchange of control in the heirarchial power structure is a direct result of the transformation from a land-based ideology to a science-based ideology.

In these terms, for the lower classes, the only real difference is that instead of reacting to, and participating in, a belief system which was established and represented by the Church and the State, and as symbolized by land, they now had to react to the industrialist and businessman who were supported by the scientist, and were symbolized by industry and technological ownership.

V

THE MECHANICS' INSTITUTE MOVEMENT

Perhaps it is fair to say that no period in the
history of Britain has been richer in radical and
social reform movements than the years from 1799 to
1851. It was during this time that education became
one of the main areas of social conflict; and by
'education', we do not, of course, refer strictly to
formal schools. Certainly these years witnessed the
emergence of various kinds of charity schools, as
well as the continuation of the established universi-
ties; however, the period is probably more noted
for its contribution to new educational ideas and
objectives, the educational impact of various
organizations and their publications, new forms
and techniques for the dissemination of knowledge,
and of popular intellectual discussion. Therefore,
as Harold Silver points out, when dealing with this
particular half-century, it is essential "to see
not only the existence or the emergence of educational
institutions, but also [to acknowledge] the profound
impact of new political and social forces, the

appearance of new pressures for education in its broadest sense".[153]

Indeed, the first half of the nineteenth - century saw a flourishing in a great variety of educational pursuits, but none was so 'in tune' with the times as adult education - as it largely focused on one characteristic feature of the period; that is, the tremendous interest in the teaching of science. Certainly by the 1830s and 1840s, science had been successfully consolidated within the cultural value system of English life. This was especially true in the provincial centers where empiricism, education, and capitalism were merging and manifesting themselves in the form of class-specific social and political power.

Although the dynamic for this sort of scientific social movement declined after 1851 (due, in part, to an increased momentum within the scientific community towards specialization and professionalization which resulted in the demise or diminishing of amateur and 'popular' science), science and 'rational thought' became all the rage in the first half of the century. During these years, the disruptive effects of the Industrial Revolution were being felt in all sectors.

For a society looking for panacea to the problems brought on by rapid social and economic shifts, self-improvement, education, and scientific/technical training seemed to be the remedy.

As J.H. Plumb states, "the pursuit of useful knowledge had acquired great momentum in urban society, particularly amongst the skilled mechanics and craftsmen, as well as factory owners. This demand for knowledge was supplied by a new and elaborate complex of cultural activities....Debating societies were to be found in every town of any commercial and industrial significance and their debates ranged over every type of scientific, political, moral, social, economic, and even religious question."[154]

In close relationship with the plethora of scientific societies which existed at the time (1,000 by 1851 according to Mann's Census)[155], was the emergence of a mass political movement. Being forged within this movement were two distinct forms of class consciousness - middle class AND working class consciousness. The impact of the interaction between these two was to have significant effects in the years to come, not the least of which being the social legitimation and institutionalization of

science, of science related education, and of the
group who manipulated or directed 'scientistic'
activity (i.e. the marginal middle class). As Arnold
Thackray states, marginal men actively sought out
social legitimation.

> "Their espousal of the progressivist
> values of Unitarianism and a
> progressivist interpretation of science
> can be seen as deriving from their need
> to justify themselves, and to do so in
> terms of belief systems that
> simultaneously affirmed their commitment
> to high culture, announce their distance
> from the traditional value systems of
> English society, and offered a coherent
> explanatory scheme for the unprecendented,
> change-oriented society in which they
> found themselves unavoidably if willingly
> cast in leading roles." 156

The early nineteenth century is often refered to
as the 'Age of Materialism[157] as this era placed a
great deal of social value on monetary wealth. This
wealth, which was most concentrated in the hands of the
professional/industrial/entrepreneurial middle class,
was almost always in some way related to the interaction
of science with society, as the majority of scientific
advance at the time sprang directly from an interest
in improving methods of production. Thus, it is not

unusual to find statements which profess the desirability
of money. One such remark is recorded by George Foote
as follows:

> "Wealth, Wealth, Wealth! Praise
> be to the God of the nineteenth
> century! The golden idol - The
> mighty Mammon! Never was there
> a period when money could
> accomplish as much as in England
> of this period." 158

Although the middle-classes were, during this
period, enjoying an unprecedented prosperity, they -
as well as the other classes - were caught in the
grips of tremendous economic and social tensions.
Traditional social habits and customs seldon fit
into the new patterns of industrial life, and they
therefore had to be discredited as being hindrances
to Progress. A prevalent view amongst the working
classes was that the cause of their misery and
difficulties was the presence of machinery and its
owners. As reported in the Advocate on 16 February

1833:

> "It is a monster that devours
> the bread of thousands. It is
> an insatiable Moloch. It is
> callous to all feeling; it is
> insensible at the sight of the
> emaciated form, the hollow
> cheek, and the sunken eye; it
> turns like the deaf adder from
> the appeal of misery; it can
> behold unmoved the poor man's
> table without a meal, and his
> hearth uncheered by a feeble

> blaze....The labour of the
> working man is his only
> inheritance; if you take from
> him that, you deprive his of
> all. Yet this the growth of
> machinery has done, or what
> is nearly the same thing, it
> has rendered his labour
> valueless, for he is denied
> adequate employment for its
> exercise...." [159]

This rather bleak, and rather Dickensian scenario does

not go unsubstantiated. It is well known that with

regards to the question of distribution of the world's

resources, Francis Place is quoted as saying repeatedly

that 'Machinery should be allowed to beat population

in the race'.

This point of view, while detrimental to

the well being of the working classes, spoke

encouragingly to, and fully supported, the potential

imperialist exploits of invention. As is reported in

the *Edinburgh Review* of August 1825, "the sacred thirst

for science is becoming epidemic, and we look forward

to the day when the laws of matter and of mind shall

be known to all men." [160] This editorial observation

was in no way isolated for a similar sentiment

was appearing in print throughout the nation. A

further example can be found in the *London Magazine* of

April 1828 which states that "Science is everywhere.

> In every town, nay almost in
> every village, there are
> learned persons running to
> and fro with electrical
> machines, galvanic troughs,
> retorts, crucibles, and
> geologists' hammers....Nor
> lack we an abundant store of
> persons of both sexes, cunning
> in mosses and in shells, who
> can at a glance know the
> texture of the small cloths of
> every hill and heath." **161**

This passage is of particular significance as it
clearly illustrates a striking division: that being
the developing seperation between science as an
amateur pursuit and science as a profession.

While the professionalization and institutionali-
zation of science hosts far-reaching ramifications,
there was an inherent inefficiency. By far, the
majority of scientific work was directed towards its
application - leaving research and development to
suffer from inattention. In this connection, Roderick
and Stephens state that "the price paid for such a
lack of national awareness was high, and must include
the loss of economic leadership for England. If it
was not *the* reason, it was certainly a major factor
in [their] being surpassed economically....by the
United States and Germany." [162] Concomitant with the
local decline of the more serious science was an

explosion in the 1840s of a very popular culture based upon the *entertainment* provided by the intrigue or mystery of the idea of science, rather science itself.[163]

In response to the popularity of 'recreational' science, science lectures became extremely widespread. Such lectures, which were generally opened to the public but were intended primarily for the 'new bourgeoisie' , covered such topics as chemistry, hydrostatics, pneumatics, optics, astronomy, botany, and mathematics. The provision of scientific instruction before 1824 was meagre; however, somewhat suprisingly, an early indication of the popularity of science came in March 1812 from the Rev. George Smith of Sheffield when he opened his Institution for Young Ladies, in which the first principles of science were to be taught.[164]

In general terms, science teaching at this time had a flavour of radicalism and reflected a very strong Puritan, rational, material orientation. While this multifacted content was directed at middle class consumers, the emphasis was on science as a 'refined amusement' for the elevation of character. However, when aimed at the working classes, the content reflected two different concerns. One emphasis was

focused on political economy, while a second advocated
a heavy diet of useful and other industrially applicable
facts.

A group who supported this working class approach
was Henry Brougham and his colleagues. In their view,
"artist sensitivity and the appreciation of poetry and
drama were too frothy for the multitude, indeed an
obstacle to their self-advancement."[165]

The prevailing middle class notion of culture in
the nineteenth century certainly excluded a knowledge
of manufacture; and it is not unusual to find only
token courtesy being paid to education by these groups.
For example, at an annual *Monster Soireé* in Manchester
in the 1850s, there was the "resolution, moved by the
Hon.____, seconded by _____, Esq., F.R.S., and c.,
supported and carries unanimously: That education is
a fine thing, and that everybody ought to promote it.
Next a song by a distinguished vocalist."[166] This
viewpoint believed in science and education as a form
of leisure. Addressing the Manchester Mechanics'
Institution, Sir Benjamin Haywood stated that "After
a hard day's work a man wants refreshment and ease.
I would urge the Directors, who are this evening to

be appointed, to let this be one of the earliest

subjects of their consideration - think, for instance,

whether social evening parties with tea and coffee,

might not be more encouraged amongst you."[167]

To this point in time, the propertyless had

remained outside the political community, however,

this condition "entailed certain attitudes towards

education. Whatever education there was had to be

limited, functional, useful in its strictest and

narrowest sense, fitting men for their station and

their duties in life."[168] Radicalism, on the other

hand, marshalled an important debate about education

as being the sole difference between men; and as a

political strategy through which to change the world.

"Man was a rational being, working-class radicals

asserted, and each man had an inalienable right to

knowledge. It was knowledge that set man above beast."[169]

The most appealing mechanism for this philosophy was

specifically adult education.

Unfortunately, the efforts of middle-class

radicals and philanthropists met, to a large degree,

with unresponsiveness in the working- and lower-

classes. "Popular sentiment in Yorkshire was probably

more accurately reflected in the voice from the back
of a crowded meeting of the Leeds Co-Operative Society
in 1872 - 'We want no eddication, give us a bonus!'[170]
Conversely, "Engels had often heard working men whose
fustion jackets scarcely held together, speak upon
geological, astronomical, and other subjects with
great knowledge."[171]

Thus, the 'March of Mind' as an expression of
the expansion of education was faced with two
polarized forces - the absence of an interested
clientele; and more profoundly, the Whig fears of
an extended political community.[172]

Jeremy Bentham and the 'Cult' of Benthamism

Based upon Newtonian physics and Hartlean
Associationist psychology, Jeremy Bentham (1748 -
1832) attempted to develop and perfect a 'science
of man'. As a reflection of his admiration for
scientific methodolgy which he believed to be the
foundation of real knowledge in every area of
intellectual endeavour, Bentham insisted that all
processes - including education - must be above all,
systematic.

This merger in thought of scientific method and knowledge, plus a 'concern for the public machine', was not the sole invention of Bentham. His influence is drawn directly from the similar thoughts of Joseph Priestly, who also "embodied both the scientific enthusiasm of the *philosophe* and the socio-political awareness of the English gentleman of sincere social conscience."[173]

It is not suprising to find that Bentham's (and Priestly's) fundamental axiom is the same as the second dominant tenet in the Puritan ethos: that is, the greatest happiness of the greatest number is the measure of right and wrong. Thus, in succinct fashion, Bentham articulated and promoted an attractive secular alternative to the 'Great Chain of Being' with its binding sanctions of devine and natural law. In approaching the public good, Bentham had no question that science and technology should form the central core of the educational process; leading directly to a sound and profitable vocational choice.

"'The Age we live in is a busy age; in which knowledge is rapidly advancing towards perfection.' This was Jeremy Benthams salutation to the intellectual world of 1776. It was a succinct expression of the

character and aspirations of the intelligentsia of the time."[174] At this time, Bentham, like many other Enlightenment enthusiasts, felt the need for replacing the scholastic, cosmetic arts of 'classical erudition with hard currency drawn from the sterling treasury of the sciences'.[175]

As a firm believer in the individualism of the scientific quest for truth, Bentham found the social, political, and economic policies associated with *laissez-faire(ism)* to be most attractive, And although he saw 'freedom' as a potent agent for historical change, he rigourously rejected the American and French Revolutions; attacking the concept of natural rights found in the *Declaration of Independence* and the *Declaration of the Rights of Man and the Citizen* as being meaningless hodgepodges. In Bentham's view, all men would always be born into a state of 'subjection, not independence'.[176]

Hence, the *laissez-faire* economics of Adam Smith and the utilitarian philosophy of Jeremy Bentham merged to form the most influential and important socio-economic ideas of the nineteenth century. Both of these philosophies placed a premium on literacy and on the education of the social classes. While it

is true that the men who drew most heavily on the
writings and teachings of Bentham were orthodox
utilitarians, it is also true that even the most
loyal of these followers carried the philosophy in
different directions.

As Brian Simon states, "the ideas and plans most
closely in line with the requirements of the middle -
class were worked out in detail by Jeremy Bentham.
Chrestomathia [177], published in 1816-7, was to have a
seminal influence of the educational thought and
practice of the Radical bourgeoisie. It embodies the
essence of the utilitarian outlook in educational
terms." [178] Thus, it was largely under his name and
doctrine that the English middle class moved toward
the capture of political power.

Utilitarianism, which was a legal embodiment of
science, sponsored the belief that an ordered society
was possible only through the application of scientific
methodology to society. In this light, society was
not an organism, but a machine that could be managed
through technical know-how. Utilitarianism, then, was
a "wholly adequate doctrine for the rising middle
class, seeking confirmation of its growing power
through reforms directed against the privileges of

the aristocracy. Its values were appropriate to the new methods of production and in its early phase served to create....political and social institutions"[179] which were consistent with the developing value systems.

Bentham himself typified the professional ideal for it was primarily the new 'marginal', upperward moving, professional middle class who stood to benefit from his vision of a scientific administration which specialized in performing functions which related to public welfare.

Benthamite ideas, or rather crude approximations, spread amongst both the middle- and the working-classes, and fostered the growth of a middle-class radicalism which articulated a variety of social programmes; not the least of which being the freedom from inefficient government. Middle class radicalism - especially in the form of Benthamism - was essentially rational and liberal, and attempted to apply the principles of Newtonian physics to politics and social reform.

For Bentham, a free press was a fundamental vehicle towards responsible government, as well as in order to secure a more complete obedience on the part of citizens under a government which was based on laws. The primary function of civil law was to

operate as distributive law in attaining the greatest good for the greatest number.

In the England of the early nineteenth century, radical educational policy was identified with the Benthamites - the 'education mad party'[180], as well as with the utilitarian principles which this group held. The Benthamites were involved in every aspect of educational endeavour, and their work was instrumental in the development of a secular system of 'popular' education: and mottos such as 'Useful Knowledge' and 'Knowledge Is Power' were constantly used in speeches and publications to attract the common people.

The tactics of the Benthamites were, indeed, successful; however, it must be seen in perspective that the *cult* of Benthamism was more important than the actual works of Jeremy Bentham - and this cult was based on hybrid popular interpretation, distortion, and 'myth'.[181]

The Mechanics' Institutes

The earlist mechanics' institutes were quite local in character and influence, and were principally utilitarian and scientific. One of the primary

objectives was to make members more industrially
competent and efficient by offering courses which
instructed in the principles underlying a craft.
However, instruction in the craft itself did not
take place. Mechanics' institutions were inaugerated
as a movement with the establishment of the London
Mechanics' Institute, the origins of which can be
traced to Glasgow in the last decade of the eighteenth
century.

In 1796, Dr. John Anderson, Professor of Natural
Philosophy at the University of Glasgow, attempted to
popularize education by establishing an 'anti-toga'
or non-academic dress. Anderson opened his classes
at the University to workmen of all kind, for whom
he provided a special evening course of a more popular
nature, illustrated by experiments. Approximately
200 individuals who were not students audited the
class, the majority of whom were work men.

On 06 June 1796, after his death, Anderson
College was incorporated as a memorial to the efforts
of John Anderson. At this College, the first professor
of Natural Philosophy was Dr. Thomas Garnett. In his
words, the aim of the College was "to promote useful
knowledge and improvements in Science and Philosophy

applied to the various branches of trade and
manufactures carried on in this populous city and
neighbourhood."[182] Garnett's stay was a prosperous
one, but in 1799 he resigned and left for the Royal
Institution in London.

Garnett's replacement was a 23 year old graduate
from the University of Edinburgh, who had been
schooled with Walter Scott and Henry Brougham. His
name was Dr. George Birkbeck.

Birkbeck stressed mutual improvement, and early
in his appointment, because of a need for special
instruments which had to be built, he was forced into
intercourse with the artisans of Glasgow whereupon
he discovered their latent genius and innovative
skills. Once impressed by the untutored ability of
the workers, Birkbeck established a special mechanics'
class.

In 1800, under the Board of Trade, the School of
Design merged with these mechanics' classes to
establish the first recognizeable technical education
for the working class. The expressed object of this
merger was the 'union of arts and sciences and the
study of the underlying scientific principles of
industry and invention.' [183]

At the first lecture in February of 1800,
attendance was only 75 but quickly grew in the ensuing
months to over 500. In his Prospectus for the first
session, George Birkbeck said that:

> "I shall deliver a series of
> lectures upon the mechanical
> properties of solid and fluid
> bodies, abounding with
> experiments and conducted with
> the greatest simplicity of
> expression and familiarity of
> illustration, solely for
> persons engaged in the practical
> exercise of mechanical arts;...."

and he goes on to say that:

> ...."greater satisfaction in the
> execution of machinery must be
> experienced when the uses to
> which it may be applied, and the
> principles upon which it
> operates, are well understood,
> than when the manual part alone
> is known, the artist remaining
> entirely ignorant of everything
> besides." [184]

Thus is set out the aim and method of technical
education.

These lectures were to continue well attended,
even through the resignation, in 1804, of Birkbeck
when he left for London. The mechanics' classes were
taken over by Dr. Andrew Ure, and although difficult
times occasionally threatened Anderson College, it
survives even today in the form of the Glasgow Royal

College of Science and Technology.

Although Birmingham claims the honour of being the birthplace of the mechanics' institute, London was actually the first site with the establishment, in 1817, of the Metropolitan Mechanics' Institution. Its members met nightly at Lunn's Coffee-House but it had a short life. Nonetheless, it did prepare the way for the London Mechanics' Institution.

On 11 November 1823, at a meeting of 2,000 persons at the *Crown and Anchor*, the advisability of opening an institute such as that opened earlier that year in Glasgow (on the advise of George Birkbeck) was discussed. On 02 December 1823, the London Mechanics' Institute was born with membership fees costing a quarterly subscription rate plus a one Pound entrance fee. Among the resolution were:

> 1) Establish an institution for mechanics at a cheap rate in the principles of their trade and other useful knowledge to improve their habits and conditions, benefit science, the arts, and the country.
>
> 2) Such institute is likely to be most stable and useful when entirely or chiefly supported and managed by mechanics themselves.
>
> 3) Thanks to the example of the Institute of Glasgow.
>
> 4) That there *will* be a London Mechanics Institue.

> 5) Said London Mechanics Institute
> will provide lectures, a library,
> a reading room, a museum of models,
> a School of Design, an Experimental
> Workshop, and a Laboratory with all
> the necessary equipment.

> and 6) Annual subscription is not to
> exceed one Guinea. [185]

According to Stephen Cotgrove, the underlying objectives
of the founders were:

> 1) The injection of science into
> the workshops of the country with
> consequent economic benefit.

> 2) The wider diffusion of science
> and rational knowledge which would
> banish 'superstition'.

> 3) The advancement of science by
> increasing the numbers of those
> able to pursue it.

> and 4) In accordance with the views
> of Adam Smith, they hoped that
> science and education would offset
> the degrading effects of the
> industrial division of labour. [186]

Thus, in 1824, the London Mechanics' Institute
formally opened in Monkwell Street, London Wall amidst
pessimistic predictions that "if"invited the mechanics
would not come; that if they did come they would not
listen; and if they did listen they would not comprehend."[187]
All this proved false.

In 1827, led by Lord Henry Brougham – 'the most
able and eloquent friend of the Mechanics now living' –[188]

the Society for the Diffusion of Useful Knowledge (SDUK) was formed for the "purpose of enabling mechanics and artisans to become acquainted with science that they may be qualified to make improvements and even new inventions."[189]

With Birkbeck as president and Brougham as chairman of the SDUK, it is not suprising to find similar goals as the London Mechanics' Institute being expressed as both Birkbeck and Brougham held the same positions in the sister-organization (LMI). An organized effort was mounted to transform middle-class reading habits via the diffusion of cheap reading material. In many ways, the SDUK was inefficient and noisy; and soon earned the name of 'the Sixpenny Science Company'.[190] Hodgen tells us that the SDUK adopted the London Mechanics' Institute for two reasons; to improve workmanship and increase profits and productivity, and to make the Institute a credit to them.[191]

There existed essentially two types of mechanics' institute: sponsored and independent. However, the almost immediate success of the London Mechanics' Institution stems largely from the fact that munificent donations were received. This early external support

came primarily from left-wing Whig sources; thus, with the gaining of influential friends (as well as of momentum), a July 1823 discussion ended with the resolution for the mechanics' to support themselves. As Henry Brougham said, "this is the moment beyond all doubt, best fitted for the attempt when wages are good, and the aspect of things peaceful."[192] This was an important decision as internal financing allowed the maintenance of the Institute ideals - while external support would compell the re-aligning of these ideals to those of the supporting group.

With the Anti-Combination Acts of 1800 and 1825 fresh in the political conscious, the Duke of Sussex warned the managers of the London Mechanics' Institute that any political or theological discussions could lead to the ruin of the Institute. These topics, Holyoake was to call the 'Terrors of Mechanics' Institutes'.[193] Nevertheless, within months, the hall was being let to Owenites, Cobbettites, and other radical groups. This was, in part, necessary as Harold Silver points out, as this sort of activity was integral to the challenge of an enlightened populace against aristocratic England.[194]

This sort of action, coupled with the involvement

of liberal agitators such as Brougham and Hobhouse,
led conservatives and the timid to associate the
Institute with radicalism. Consequently, efforts were
made to become 'respectable'; and, in order to avoid
the taint of Radicalism, politics, political economy,
and theology were rigourously avoided. "Some of the
more enthusiastic supporters of popular education
still hesitated to give more than a guarded expression
of their belief in the advantages of bringing scientific
knowledge within the reach of all classes of the
community; and this is scarely to be wondered at, when
we read in the *St. James Chronicle* of May 1825, with
reference to Birkbeck's scheme, that 'suggestions more
completely adapted to the destruction of this Empire
could not have been invented by the author of evil
himself!'" [195]

Political tensions were also visible within the
Institute as Hodgkin and Robertson, who were its
original sponsors, lost control largely because of
the efforts of Francis Place, who was opposed to
Hodgkin's militant anti-capitalism. "Place, unlike
Brougham, was against control of the institutes by
the working men themselves since they cannot be in a
condition to take charge." [196] Conversely, Brougham's

view is succinctly stated in his 1825 pamphlet entitled *Practical Observations Upon The Education of the People* in which he states that "the working men should have the principal share in the management of Mechanics' Institutes."[197]

Here may be seen a certain division between two strands of radicalism, since Francis Place had opposed the appointment of Hodgkin to lecture at the Institute for fear that his ideas would convert the London artisans to opposition to the established order of society. From here the working class strand of radicalism began to merge into the co-operative movement promoted by Robert Owen, which blended with Hodgkinite ideas. Essentially, the proponents of working class radicalism were self-educated men who were interested in the Rights of Man; and who had been influenced by the anti-capitalistic doctrines of the anti-Ricardian economists - especially those put forward by Thomas Hodgkin.

As Douglas Long explains,[198] the working class radicals (taking a crude Benthamite position) called for the 'political machine' to address its energies to attaining the greatest happiness for the greatest number. The eventual aim of this group being that political notions and political radicalism were to be pushed further down into the social

structure. For Place, however, the greatest number did not know where the greatest happiness lay; and thus, his vision was an elitist version of working class radicalism with the middle calss radicals educating the workers into 'suitable' notions.

Following the London example, other institutes sprung up throughout the country; all sporting similar mottos and objectives. The Yorkshire Mechanics' Institute expressed their object to be "to supply, at a cheap rate, to the different classes of the community, the advantages of instruction in the various branches of science, which are of practical application to their several trades or occupations." [199] The emphasis shifts slightly with the New Mechanics' Institute of Manchester which stated that "Man is neither born wise nor good:his wisdom and goodness are the results of education." [200] This theme was echoed in the motto of the Bradford Mechanics' Institute which stated that "Knowledge Is Power".[201]

Each region displayed evidence of its own experience and particular needs. In the rules of the Leeds Mechanics' Institute, established in 1824, there was expressed the wish to "improve the skill and

practice of these classes of men who are essentially
conducive to the prosperity of this large manufacturing
town."[202] In York, the attendance and membership was
somewhat less than expected and this was attributed,
by the Institute mamangement, to the 'fact' that "except
when illustrated by a profusion of brilian experiments,
one cannot obtain an audience."[203] The less numerous
Scottish institutions were less effective owing to
their practice of closing entirely during the summer
and autumn months.[204]

In general, it was not the evening lectures which
educated the working-classes, although the pleasures
of these presentations eventually accrued to the
middle and upper cllasses due to the entertainment
value of the evenings. Examples of this sort of *'civil
soireé'* are plentiful - such as that reviewed in *The
Beehive* in 1863 which read "by the request of the Ladies
Sanitary Association, a lecture was delivered by Edwin
Lancaster, Esq., M.D. The Subject: 'The Necessity of
Fesh Air'."[205] Knowing *The Beehive*'s political affiliations,
this might well be a piece of sarcasm.

Indeed, the most valuable and enduring feature of
the Mechanics' Institutes were the libraries. In
the first two years of operation, the London Mechanics'
Institute acquired over 2,000 books - mostly of a

technical nature. General literature and fiction were
rigidly objected to. Furthermore, works on politics,
theology, and political economy were not permitted.
This was the attitude adhered to by such conservative
legislations as the Public Libraries Act of 1850 which
allowed only books considered fit for lower-class
readers to be included. This is seen as contrary to
the supposedly educational aims of these organizations.
The value of the library was so widely recognized that
Workman's Libraries were organized in (for example)
Glasgow (the Glasgow Gas Workman's Library - October
1821). Even mobile libraries became a common sight.

The aim of most institutions included, as we
have seen, making members more industrially competent
and efficient. Perhaps with no other group was this
aim carried to such extremes as was at Wakefield in
1825 where the President (the Rev. M.J. Naylor)
offered assistance, when funds would permit, to
members for the patenting of any useful invention
which they might make.[206] But not all institutions
prospered. Some petered out after the original
members left; others became billiard saloons for
small cliques; while others simply evolved. The

London Institute became a branch of the City Polytechnic (todays Birkbeck College of the University of London), and the Manchester organization slowly became the School of Technology.[207]

In November of 1832, the Sheffield Mechanics' and Apprentices' Library was transformed into the Sheffield Mechanics' Institue. Its main concerns were focused on "the diffusion of literature in connection with religion among the youth and working classes in Sheffield.[208] This move towards cultural activities for the labouring classes was to gain popularity and was to be given voice by Brougham on 21 July 1835 at the Manchester Mechanics' Institute. It was there that he called for a "refining of [the] appetites of the workers, and removing them from low, sensual gratification."[209]

It was during this period from 1830 to 1849 that a considerable number of working class and radical movement educational efforts were to be formed. It was in this temporal framework that popular discontent was focused, primarily through the Chartist movement. Gaining its initiative from Owenism, the 'defiant self-culture' demanded Parliamentary reforms. These groups demands were formulated in meetings, lectures,

and public protest.[210] This radical image was spread by conservatives to society-at-large, and often resulted in workers who were affiliated with a working class organization being forced to leave the institution under threat of dismissal by their employers.[211]

The 1840s emerged as a time of stark opposition. It was commented in the *Edinburgh Review*, with regards to the motion made by Lord John Russel to the House of Commons in May 1845 on the State of the Labouring Classes, that "one of the most markes characteristics of the present time is the large amount of public attention which is given to the working classes."[212] It has been noted, for example by J.W. Hudson, that in Liverpool between 1840 and 1846, attendance at lectures ranged between seven and fifteen hundred, but by 1849 this had dwindled to only three hundred persons.[213]

Diversification was the order of the day. Public lectures were given on a miscellany of topics and seldom were repeated. William Ellis opened his first Birkbeck School in the London Mechanics' Institute in 1848 specifically for the children of the working classes. However, this diversity was usually at great cost. The serious students were often the first to

leave as the programmes being established ranged from jurisprudence to the structure of chimneys, and from hydrostatics to Greek and Roman antiquities. The curricula was no longer geared for the working class. Even so, by 1850, there existed 610 institutes in England, and 12 in Wales cummulatively representing a membership of over 600,000 persons.[214]

This large following can be explained by the fact that the interest in the wide variety of 'popular science' courses and lectures was enhanced to an unusual extent by the growing excitement over the upcoming Great Exhibition of 1851 at which England, and her citizens, would show the world the advanced level of her scientific and technological skill. But the Exhibit only confirmed the worst, and rumours circulated that England was rapidly losing ground.

This bruise to the national pride sparked a renewed sense of urgency regarding the need for better technical education in England and resulted in the new availability of grants and other support programmes from the government. The creation of the Department of Arts and Science in 1853 was a direct response to this need. As Lawson and Silver point out, however, "after 1850, the dynamic of this kind of social movement

declined. The new radical politics and movements of
the 1860s and after were less concerned with education
from below than with pressures for free, compulsory,
state-provided education."[215] The mechanics' institutes
had accrued to tradesmen and clerks, and had become
finishing schools for small businessmen. This was done
by substituting literature for science and mechanics'
courses.[216]

Partially stimulated by the Commissions on
Technical Education of the 1870s and 1880s (e.g. the
Devonshire Commission Reports of 1871/2), Technical
Colleges grew out of the mechanics' institutes, while
others were created in the 1890s. For example, in the
district of Finsbury, the City and Guilds of London
Institute was created in November 1878 as a direct
response to the opinion of successive Royal Commissions
on education that the maintenance of British industrial
supremacy depended on the active promotion of technical
education.[217]

In this connection, as the need for an educated
citizenry was recognized late, it could dramatically
be stated that 'the Lion had slept too long'.[218]

Self - Help

   The mechanics' institutes played a central role
in establishing the process of self-education both
locally and nationally. Up to the appearance of the
institutes, most provisions for adult education were
ill-equiped to cope with the fast changing social
conditions. Thus, as a partial response to these
conditions, the philosophy of self-help was important.

   According to Roderick and Stephens, self -
improvement can be defined as "intellectual rather
than purely moral improvement, though the two are of
course usually linked, and it further implies
improvement undertaken by an individual of his own
set purpose, in his own time, and often at the cost of
some effort or sacrifice."[219] As Samuel Smiles stated
in *Self - Help* , "what some men are, all without
difficulty might be. Employ the same means and the
same results will follow."[220]

   The triumph of self-improvement could eventually
be reduced to a few moral questions. There was no
mystery. Innate genius was not needed. What was
needed was work, diligence, careful cultivation of
one's potential, self-control, and sobriety - in
short - Puritanism. Work was especially important.

Idleness was a sin and self-improvement through
education was the way to salvation (and prosperity).

Although based essentially on middle-class
optimism, self-help was the only form of education open
to the young, adult working class. Its sucess can be seen
from the quality of the labour aristocracy which
emerged; however, this group only represents a small
percentage of those to whom self-help was directed. As
Samuel Smiles states in *The Education of the Working Classes*,
"the education of the working class is to be regarded,
in its highest aspect, not as a means of raising up a
few clever and talented men into a higher rank of
life, but of elevating and improving the whole class -
of raising the entire condition of the working class." [221]
This it did not do.

The characteristic vehicles for self-help were
the various institutes for adult education, such as
the mechanics' institutes. The numerous inexpensive
encyclopedias and magazines which disseminated popular
science throughout this period (i.e. 1790 - 1851) we
also instrumental.

However, it must be cautioned that those actively
pursuing self-improvement (whether at a mechanics'
institute or not) represented a very small portion of

the total lower and working class population. Even
into the 1850s, more than half of these people could
neither read nor write; but the self-taught among them
did try to preach self-instruction and organize small
groups for mutual improvement.[222]

Education and Social Control

In the rapidly changing industrial world of
nineteenth century England, there was a sense in
some sectors that knowledge, like a number of other
social instruments, would bring about immediate
social improvement. "This emphasis on the external
control of the environment, which is a hallmark of
modernization, reflected the very real fear that
inner control was slipping away....It was under a
threat of social dissolution that the preoccupation
with social control arose."[223]

Thus the relation between education and crime
was established; with the conclusions being drawn
from this equation depending largely on whether one
held optimistic or pessimistic beliefs about the
nature of social change. To many, the main argument
in favour of the instruction of the lower social

orders was one of police. As Cotgrove points out, "at
a time of social unrest and fear of revolution, it is
not suprising to find that a major aim [of education]
was to 'gentle the masses'."[224]

To the middle and upper classes of this society,
crime was only one other carry-over from an unscientific
world; the secret of its prevention lay in the logical
application of scientific methodolgy. Therefore, in
this particular relationship, the requisite 'technological
fix' to crime was education. This position was fairly
widespread, as can be seen from the *Edinburgh Review* of
October 1847 which states that:

> "the only effectual prevention
> of crime [is] the influence of
> Education. To educate the masses
> - to reclaim neglected multitudes
> from that gross ignorance, and
> with it those temptations to vice
> in which they are involved, and
> to bring them under the influence
> of a wholesome intellectual and
> moral training, is the great and
> permanent duty of the people of
> England." 225

Evidence of this viewpoint is common - for example, in
an 1837 *Address on Education*, authored by William
Lovett, he states that "ignorance is the most prolific
source of evil and knowledge the most efficient means
of happiness, and therefore it is the duty of the
Government to establish *for all classes* the best

possible system of education". [226]

In the words of one of the speakers in a
Parliamentary Debate in 1820, every poor man "ought
to be made sensible that there is an attainable good
in this life superior to animal gratification" [227] and
it was hoped that the mechanics' institutes would draw
men away from 'intoxicating liquor' and 'sexual
excesses'. Education would not only end poverty, but
would also improve the moral character of the people
as well. Thus, the conservatives need not tremble.

While a few radicals, such as Thomas Hodgkin, saw
education as working a peaceful revolution and changing
the framework of society, the Utilitarian proponents
of education, such as James Mill and Henry Brougham,
never thought that education would eliminate social
classes. Hard work and individual initiative, two
qualities which were useful in business, also applied
to education and would enable the ambitious to advance
themselves within the existing social system. There
still had to be poor, but it was becoming increasingly
easy to say that they were poor not because God chose
them to be so, but because they lacked the requsite
perserverance and character.

This was the great motivation for the self -

educated man. However, as Osbourne reminds us, the
gulf between the possibilities of education and the
reality of daily existence remained wide. The self -
educated were in a small minority and a work-man who
could read a newspaper was regarded as a scholar by
his fellows.[228]

In terms of the mechanics' institutes' perceived
function as a social controller, it was felt by many
employers in the 1830s and 1840s that the institutes
in particular, and education in general, "not only
protected them against rick-burning and machine
breaking; [and] not only improved the general moral
tone and intelligence of workmen, but [they] also
improved their work."[229]

Throughout this period, there still existed a
good portion of society who saw the 'March of Mind'
and education as being socially dangerous. Especially
amongst the upper classes, there was a growing
distrust of critical attitudes; and educated workers
- even if they were only semi-literate - were potential
revolutionaries. As was stated in *Blackwoods Edirburgh
Magazine* in May 1825:

> "We cannot be ignorant that,
> hitherto, whenever the lower
> orders of any great state
> have obtained a smattering of

knowledge, they have generally
used it to produce national
ruin.....We maintain that if
such men as Mssr. Brougham,
Burdett, Place, and Co. be
suffered to direct the
education of the people, they
will pervert it into the
misleading and delading of the
people into a national curse." 230

As this group continued to cling to the idea of a
land-based social heirarchial power structure, this
unpopularity was enhanced by a prejudice against
industrialization itself as, they insisted, England's
greatness had been built upon land and *not* upon
machines and manufactures. This upper-class attitude
further demanded that the people must remain ignorant
and poor.

At this time, the middle and upper classes feared
the education of the poor above their station primarily
because they themselves lacked confidence in their
own claimed superiority. As Richard Katz states,
"adjustive-utilitarian attitudes can be changed, but
ego-defensive ones cannot".231 "Thoughts and Thrones,
the aristocracy knew well, could not co-exist: the
education of the poor was limited, in the interest
of the rich." 232

The fears of these individuals were magnified
even further with the enactment of the Ten Hour Bill

of 1847 which effectively increased the leisure time
available to the workers. As Harrison has shown, these
Acts allowed the increased success of beershops which,
in turn, resulted in increased civil misbehaviour.
However, it also allowed additional free-time with
which to pursue education.[233]

Thus the mechanics' institutes were pressured from
two sides. On the one hand, they were considered by
many to be subversive and a general threat to the social
order; while on the other hand, some of the working class
feared that the institutes were being controlled by the
managing classes, and therefore, avoided them as they
were potentailly centers of social control. According to
Brian Simon (e.g.) it is in this context that Chartist
Halls sprang up.

Numerous examples of these perceptions exist. As
early as 1823, *The Times* expressed their perception of
the soon-to-be-opened London Mechanics' Institute by
stating that the institute would be (if properly
conducted) useful to the artificers by "substituting
more rational pursuits in their hours of relaxation
than those to which they are driven at present"[234]On
the same topic, *The Public Ledger* stated that "An
address to the mechanics' of London is now in circulation,
advising them....in imitation of [that] of Glasgow, to

form an institution for the purpose of receiving lectures on the principles of mechanism, of which many of them are grossly ignorant. Could this useful body of men be induced to refrain from spending their time in public-houses, to the injury of their health, the obscurity of their understanding, and the material detriment of their families, we should rationally hope to see more permanent and beneficial reform in their minds and manners."[235] Similarly, the Radical and Chartist speaker - Richard Lowery - claimed in a speech on 29 September 1838 that the mechanics would not be allowed the management of the institutes as "It is our intelligence they are afraid of; they know if we had the franchise, we would no longer allow them to rob us of our rights."[236] Furthermore, it was not uncommon to find references - in such journals as *The Mechanics' Magazine* - which pointed out that "amongst the working classes, the prevalent impression is, that all new inventions in machinery, and all improvements in the old are highly injurious to their interests, whilst they are beneficial to their employers."[237] It was considered the norm that - with regards to national education - the middle - class recognized the need with thier tongues, and not their hearts.[238]

Throughout the turbulent first half of the 19th century, the political implications of both technology and education

were quite plainly drawn by entrepreneurs and their repre-
sentatives. "Andrew Ure, for example, could then describe
the self-acting mule as a 'creation destined to restore
order among the industrious classes....The invention confirms
the great doctrine already propounded that when capital enlists
science into her service the refractory hand of labour will
always be taught docility."[239]

The Question of Class

The rise of the mechanics' institute movement can be
explained only in terms of the industrial & social setting in
which it existed. While essentially reacting to, and consequently
reinforcing the norm of the dominant political & economic
elites, the institutes operated amongst intense social conflict
and the division of society into polarized classes.

By the mid-nineteenth century, most social levels believed
in the promise of science, the power of reason, and the need for
freedom of thought; and the Utilitarian programmes of a 'scientifically'
administered society were in full swing. Thus, in view of the application of
scientific methodology - that is, 'scientization' - to politics,
the 'technological fix' became in itself, a political force
which further legitimized the culture of science.

Initiated by the complex nature of daily industrial work, education
quickly became involved in the numerous political & social movements
of the day. This was the beginning of relations between the State and the

citizen. Political radicalism was basically divided
along class lines into middle and working class
traditions; and for both, the growth of a unified class
consciousness was relentless.

For the workers, the main spur to political
activity was unemployment, and therefore, any relief
from social tensions usually occurred in times of
improved economic conditions. As William Cobbett said,
"I defy you to agitate a fellow with a full stomach".[240]

The prevailing working class view was that
education was a useful instrument for both social and
political emancipation. This sentiment is expressed in
the *Mechanics' Magazine* of 1824 which stated that "Nothing
can persuade us but that all systems of education are
false which do not teach a man his political duty and
rights."[241] Some twenty years later, the fight for
education and political emancipation was continuing
as a correspondent in the *Tailer's Advocate* (06 December
1845) wondered: "why are the millions swayed by a few?
Because knowledge is power....Have not, in these later
days, the arts of Literature found their way into the
haunts of toil?....The battle of improvement is now
fought with the tongue and the pen, and every man
should be qualified to share in the glorious strife."[242]

As Peers has noted, the mechanics' institutes were, on the whole, "conceived in a spirit on benevolence by leaders drawn from the more fortunate classes of the community. These leaders certainly believed that they were acting in the interests of those whom they served, but they also believed that in so doing they were safe-guarding the good order and the prosperity of the nation as a whole."[243] Thus, working class demands for a scientifically-based education was met with an elitist wish for a more skilful, inventive, and passive labour force. In short, the middle class saw education as a highly desireable form of social control.

The working classes, especially in the first two decades of the nineteenth century, had no distinctive ideology of their own; however, through their shared experience of labour and living conditions, their common fears and aspirations slowly fused in a group solidarity. This developing unity was somewhat accelerated by the increased opportunities for education and discussion, and became increasingly visible from the 1830s onwards. According to Johnson, "working class culture is formed in the struggle between captial's demand for particular forms of labour power and the search for a secure location within this relation of dependency."[244]

In this environment of tension, education became a political battle with the mechanics' institutes reflecting the educational and politico-economic aspirations of the working

class. Thus, although the workers had not yet entered politics, they had become a political issue, and as such they slowly began to represent their own political demands and speak up on their behalf. In so doing, they became an independent political force. To all social levels, systematic education *plus* political agitation allowed social transformation. To the working classes, as it was for all classes, education had become a political tool.

As the middle class gained definition, it utilized Radicalism as a political expression. To the politically conscious middle class, the Whigs and Tory landowners represented the aristocratic factions who had, until then, effectively kept the industrialists out of power.

But the nineteenth century saw the gradual replacement in government of the aristocracy by entrepreneurs. As J.H. Plumb states, the traditional "establishment was caught in a dilemma. The economic profits of invention became steadily more obvious. Expansion was profitable, desireable: all liked wealth. But the quickening commercial and industrial life was creating opportunity for many who would have had no obvious opening in traditional society. For these people without traditional status, the route

upwards seemed to lead through the acquisition of
useful knowledge."[245] The simple maxims of utilitarian

philosophy, liberal economics, and a complementary

religious ethis provided the middle class with all the

guidance they needed.

> "of the political and moral importance
> of this class, there can be one opinion.
> It is the strength of the community.
> It contains beyond all comparison, the
> greatest proportion of intelligence,
> industry, and wealth of the state....
> The merchant, the manufacturer, the
> chemist, the artist, those who
> discover new arts, those who perfect
> old arts, those who extend science;
> the men, in fact, who think for the
> rest of the world, and who really do
> the business of the world, are the
> men of this class."[246]
>
> *Westminster Review*
> 1824

Furthermore, the middle classes (unlike the

landed upper classes) did not try to isolate themselves

socially. They were much more aware of the necessity

of educating the growing work force. Indeed, opposition

to the mechanics' institutes arose partially because

they reflected the middle class scientific ideology;

however, as T.S. Ashton has argued, this ideology

provided some osmosis between class lines. The

fluidity of class distinction raises the question of

the position of the labour aristocracy as well as of

the 'marginal men'. For both, reason was no longer a
restricted philosophy, but was now a weapon of social
class.[247]

The Mechanics' Institutes - A Modern Perspective

It was Robert Elliot who, in 1861, said "the
banquet was prepared for guests who did not come" [248]
and it is perhaps this phrase which best encapsulates
the perceived failure of the mechanics' institutes.
Most modern analyses of this movement focus on the
historical origins, the motivations, the social class
composition of the membership, and so on, but as both
Royle and Inkster emphasize, any analysis of this
sort cannot be divorced from the social environment;
indeed from the reflection in reality of a series of
wants or functions. [249] We must be cognizant of the
latent, and yet implicit, functions which are not
overtly stated. In short we must examine not what is
said, but what is done.

The single largest complaint about the mechanics'
institutes is that they failed to teach science to
the working classes; and this is closely connected
to the sub-theme that the institutes did not attract

the intended classes. What must be realized, as Royle points out is that the "mechanics' institute movement found, not an eager adult population ready to learn the wonders of science, but a semi-literate population of youths, needing the most elementary education."[250] Thus we can explain two aspects of the phenomenon. As the scientific lectures were somewhat appealing, at least to educated persons such as those typically found in the upper classes, it is reasonable to expect that it is they who would attend. Adding to this group would be those of the working class who, because of 'self-improvement' (e.g.) also found the popular lectures of interest. Once in the company of middle- and upper-class individuals, the worker would then begin aspiring into into the higher ranks. During this process those workers who did not acquire the necessary tools would be inevitably left behind and subsequently would abandon the institute. This line of reasoning is followed by, for example, Ashton, Harrison, and Perkin; and would be viewed by Thackray as a process of osmotic social legitimation.[251]

In view of the working class educational and cultural background, it is clear that the appeal to study advanced science was irrelevant to the majority,

and it has been suggested that the inclusion of recreative activity may have been found attractive [252]; however, the assertion remains that either as a hall of popular lectures, or as the place of recreative activity, the mechanics' institutes only represented one attempt by the middle class to impose their own class-specific interests and wants upon a subordinate (if not always receptive) lower class. As such, the institutes did not promote fluidity between classes, but rather, preserved a rigid social structure.

Summary

. As we have seen in the above examination, the period from 1795 to 1851 was one in which much of England's society was divided into large groups of opposing opinion. From the disagreement over the social desireability/[or] danger of education, to the middle class domination of political power, this half-century presents numerous potential avanues of pursuit and perspective for the historian who is interested in social change.

However, directly in terms of this study, it becomes clear that the mechanics' institute movement

can be interpreted as being a powerful representation of the further social legitimation of the 'scientized' middle class. As we recall from the last chapter, the provincial associations and the Royal Institution provided examples of the transformation of the national power structure from a political system based upon state power to an 'unpolitical' class rule based upon wage-labour and capital.[253]

As a continuation of this transformation, the maechanics' institutes offered, for those who accepted the professional/scientific ideology, the temporary dissolution of class lines so as to accept new members.[254] However, as Shapin and Barnes state, "most of the [mechanics' institutes] attempted to achieve a transformation in the *values* of those who attended them." With the clientele thought of by the management as the 'designated target for social control', the institutes subscribed to the view that "what people believe can only be either a simplification of scientific truth or a corruption of it; hence the diffusion of scientific knowledge to 'popular' audiences has been considered only in terms of 'filtration' or 'adulteration'."[255] In this view, for the majority who did not take on the professional/scientific ideology, the mechanics' institutions offered a social scientism via courses in docility, control, and increased production.

VI

CONCLUSION:

EDUCATION, SCIENCE, AND THE SOCIAL ORDER.

In the foregoing pages, we have presented a broad range of historical events which, directly and indirectly, involve the co-development and institutioanlization of education and science. This development has been interpreted in terms of social control and, using education and science as the primary instruments of control, has focused on the terms 'ideology' and 'scientism' as expressions of the structural imposition desribed throughout the text.

This approach to structural domination is not new. As the writings of (for example) Marx, Weber, Huxley, Marcuse, and Habermas attest (in similar but similar ways), both education and science have a lengthy history of being recognized as potential forms of social control and domination.[256] To illustrate the rich diversity of opinion which exists within this tradition, it has been argued repeatedly by some American revisionists, like Michael Katz, and by Richard Johnson (in the case of England) that science, education, and the social structure are *used* for ideological imposition. However, such scholars

David Hogan, David Tyack, Samuel Bowles, and Herbert
Gintis are critical of this approach, and argue more
from the perspective of *structural imposition*, although
each in a different way and with qualifications.[257]Engels
largely agrees as he saw the rise of science as a
response to the needs of an expanding middle class, and
the generation of a scientific middle class ideology as
an unconscious process. Aside from the underlying theme
of economic determinism, Weberian sociology essentially
agrees.[258]

As we have seen during the period of Englisg history
from 1660 to 1851, the scientific ideology - which began
as a somewhat isolated 'fire in the minds of men' like
Francis Bacon - became *the* major form of social cognition.
This was achieved because applied science and technology
permitted and encouraged the total transformation of
society from a feudal land-based system to one based on
entrepreneurial expertise and industry. This transformation
also involved a dramatic transition in the locus of control
over the power structure from aristocratic lineage to
professional middle class. The essential 'ingredient' in
the former was royal association by birth - a biological

qualification. The essential 'ingredient' in the latter was skill in the form of both managerial and technical expertise. Access to the former was restricted by chance. Access to the latter was open to anyone willing to act according to the protestant ethic which emphasized hard work, honesty, and thrift regarding the expenditure of both time and money.

With the rise of science at the hands of the emerging and expanding professional middle class who subscribed (perhaps unconsciously) to a scientific ideology, technological and political systems came to reflect a class-directed rationalistic orientation toward the control of Nature, and toward the nature of control. As has been repeated throughout the text, this ideological imposition was increasingly *structural* and not *personal*, and represented a response to the widespread utilization of science and technology in social and economic contexts. As Herbert Marcuse has posited, "the traditional notion of the 'neutrality' of technology can no longer be maintained...[T]he technological society is a system of domination."[259] He elaborates on the non-aggressive form of domination by stating that "technological controls appears to be the very embodiment of Reason for the benefit of all social groups and interests - to such an

extent that all contradiction seems irrational."[260] Within
this context, the development of formal educational
institutions have largely been seen as adaptive responses
to the dominant social value system. This system was —
in England from 1660 to 1851 — increasingly scientistic
and reflected the distinctly rationalistic orientation of
the dominant professional middle class.

Throughout this final section, we have repeatedly
used words which, by now, have become recognized as being
the key terminology of this thesis. Among these terms
are 'ideology', 'scientism', 'rationalistic', and 'class-
specific'. These terms all share at least one thing in
common — that is, they all deal with orientations, or
ways of viewing the world. Indeed, in studying education,
science, and society, it can be said that this thesis
is essentially about the transmission and use of ideas.
However, the ideas with which we are concerned are not
mere abstractions. They have been tested in praxis —
these are ideas which are active in changing the 'real
world' and which have been identified as being central
to theories of social stratification and class conflict.
As Jurgen Habermas has recently noted, class interest
"serves as the *a priori* link between the origins and

the applications....of theories."[261]   That is, human

interest directs both knowledge and action.

Thus, in order to examine the inter-relationships

involved between education, science and technology,

and the social order, this thesis has focused on the

emergence and development of scientific associations in

England from 1660 to 1851. This investigation has

revealed connection between large groups of amateur

and professional societies and organizations spanning

more than two centuries, and has consistently interpreted

their activities in terms of class-specific ideology and

belief systems.

As we have seen, the coffee-houses of the seventeenth

century provided an environment which was conducive to

the transmission of ideas, and the open construction of

the establishments resulted in a blurring of class lines'

due to unrestricted circulation and discussion. These

discussions were frequently progressive in nature, and

often focused on science, technology, economics, and

politics. However, with the influx into the popular

coffee-houses of lower-class groups, many 'houses'

reverted to a closed or segregated construction which

no longer permitted open debate and conversation, but

rather promoted privacy. The result was a re-acknowledge-ment of class barriers, although these could be transcended in favour of shared interest such as science and technology. With time, these more specialized and select groups evolved into full-fledged science-oriented associations, and sported members who were generally of middle class entrepreneurial status. These clubs refined a scientific ideology which was (seemingly) as dependent upon expertise as it was upon status. The age of the virtuoso, or curiousity seeker, had begun.

With the establishment of the Royal Society in 1660, the world of science had received official recogni-tion, and thus became a socially acceptable amateur pursuit or past-time. While the activites of the founders were primarily directed by 'true' scientific interests, the Society quickly deteriorated into what was essentially a gentleman's retirement club, and the criteria for entrance were no longer based upon scientific skill or cognitive ability, but were rather based upon social status. Although these individuals did little in the way 'real science', they nevertheless clung to scientific terminology and pseudo-scientific activites (e.g. journals) with vigour. Their love of the 'apparently scientific' was most noticeable in their 'rationalistic'

view of society and their protectionist view of the
social order. This description does not, however, do
justice to those within the Society who *were* actively
interested in science, although this group was in the
minority and eventually, under the leadership of Charles
Babbage, left the Royal Society in order to form the
British Association for the Advancement of Science.

The period from 1660 to 1851 was an energetic one
for England as this was the period which is generally
credited with housing the so-called 'Industrial
Revolution'. It was during these years that science
became the major form of social expression and activity.
The popularity of science was at a peak, with industrial
applications dazzling the world with their speed and
efficiency, and educational lectures and demonstrations
very much in demand. The total of Nature seemed
inevitable and everyone waited expectantly. Everyone,
that is, except the lower classes. For the new professional
middle classes, the world was theirs for the asking.
Through the ownership of industry and the possession of
capital generally, they had begun to reap the benefits
which traditionally had been available only to the
aristocrats - power, wealth, and prestige. And certainly
this was something worth both maintaining and protecting.

It was also a period which saw the emergence of a tremendous number of provincial scientific associations. The majority of these were established by distinctly professional and industrial middle class groups. Contrary to the conservative membership of the Royal Society, many of these provincial industrialists were progressive Dissenters who were genuinely interested in technology. Although their activites can be interpreted as being motivated by class interest, the actual scientific and technological benefits derived from many of these associations was substantial. An excellent case in point was the Lunar Society of Birmingham.

Productive and significant though they were, the provincial societies and the Royal Institution neverthe-less represented and supported the interests of the professional/industrial middle class, and as such supported the industrial forms of production which were the sources of the new social power. Partially as a consequence of the scientific community's support of the dominant class, the structural domination and imposition of interests which conflicted with the interests of the workers was maintained.

The period from 1799 to 1851 also witnessed the

emergence of the mechanics' institutes which comprised
the first widespread and systematic attempt to offer
formal scientific and tecnological education. The
popularity of these institutions largely represented
a dualistic response to both the needs of the professional/
industrial class and of the working class - for technically
competent workers who could maintain machinery and
production levels, on the one hand, and for technical
competency which could conceivably lead to upward social
mobility through expertise; on the other. Although well
attended by workers throughout the 1820s and 1830s, the
institutes of the 1840s admitted a growing number of
lower-level managers as well as professionals to their
membership. According to Brain Simon and others, this
influx of entrepreneurs was met by a corresponding
'exodus' of workers in favour of the Chartist Halls of
Science and other similar organizations.

Much of this shift in membership was reflected in
the changing curricula of many institutes. For example,
it would appear that some workers desired a somewhat
broader array of courses which included not only the
strictly technical and scientific, but also the political.
As Engels wrote in 1844,

>"The Mechanics' Institutes are organs for
>the dissemination of the sciences useful

> to the bourgeoisie....Here all education
> is tame, flabby, subservient to the ruling
> politics and religion, so that for the
> working man it is merely a constant sermon
> upon quite obedience, passivity, and
> resignation to his fate. The mass of the
> workong men naturally have nothing to do
> with these institutes, and betake themselves
> to the proletarian readin rooms and to the
> discussion of matters which directly
> concern their own interests." 262

It was these matters which essentially lay behind the
'really useful knowledge' which radical artisans sought. [263]
But perhaps what is more important for understanding the
functions of mechanics' institutes is not what was
taught, but why it was taught, and indeed, the changes
in courses offered reveals a response to the interests
of those in attendance: More favourable for the
professional middle class was the shift in curricular
content away from 'hard core' science and technology,
and toward a more popular 'science-as-curiousity'
approach. Less favourable for the working class was
this 'popular' shift away from the practical, and
even further away from the subjects of politics and the
economy.

Thus, while the mechanics' institues became highly
contentious in their own day, they nonetheless provided
(especially during the 1820s & 1830s) a service for the
workers by better preparing them to operate successfully

in the work place, or by providing classes in the
'three R's'. Indirectly, this might also be seen as
a 'service' to organized labour in its infancy. [264]
However, modern scholarly discussion of the failure
or success of the institutions still revolves primarily
around the perceived desirability of the institutes as
a form of social control, or around the perceived
potential danger to the social order which was posed
by the extension of education to the workers.

Given the above, this thesis has presented a perspective
which has emphasized the role of ideology and human interest
in the development of capitalism, technology, and formal
education, and in so doing has necessarily dealt with
conflict, social action action, and forms of social cognition.
It has, perhaps, asked more questions than it has answered.
Such questions include 'How do rationalist orientations
dictate the design of social structure?', 'To what

extent do these orientations inter-relate with more 'humanistic' orientations?', 'Does one form of orientation exclude or distort the other?', 'How can historical examinations (such as this) aid modern society in the effective adjustment and response to current educational, scientific, and technological problems?', 'Is there a linear, gradualistic correlation over time between societal and scientific factors, or is the correlation punctualistic and irregular?', 'Is there a correlate at all?', 'How effective are certain forms of knowledge or curricula as communication systems "carrying messages of social control"?'.[265]

However, this thesis has shown consistently (but by no means conclusively) that the professional/ scientific ideology which was generated by the emerging middle class was modified in its structural transmission to the lower orders of society, and that this modification was essentially a scientism which minimized the opportunity for upward social mobility and perpetuated a social system upon professional class privilege.

APPENDIX A

*Aproximate Degree of Social and Economic Influence upon the
Selection of Scientific Problems by Members of the Royal Society* [x]

	Total For 1661, 1662, 1686, & 1687	
	No.	%
Total...........................	806	100.0
Pure Science....................	333	41.3
Science Related To Socio-Economic Needs .... (e.g. Marine, Mining, & Military Technology)	473	58.7

x :from Merton [1970], p.204

*Comparitive Indices of Interest in the Several Sciences, as per
the Philosophical Transactions of the Royal Society of London :
1665 - 1667*

	Merton[x]	Comparison[y]
Physical Sciences.............40.8		38.8
Physics.....................10.3		11.1
Zoology.....................4.7		5.5
Medicine...................10.3		11.0
Botany......................3.3		2.0

x — Merton [1970], p.47.

y — de la Mothe [1981]

Evaluation of Social Mobility of Occupations[x]

Iron Master............................Upward

Printer................................Neutral

Stationer..............................Neutral

School Master..........................Neutral

Surgeon................................Upward

Unitarian/Independent Minister......Neutral

Dissenting Minister..................Neutral

Physian................................Upward

x - Inkster, Ph.D., Appendix 5.3,

  Occupations of Science Activists in Liverpool, 1820 - 1830

APPENDIX D

Number of English Patents of Invention Granted between 1660 & 1790[x]

1660 – 1669..31

1670 – 1679..51

1680 – 1689..53

1690 – 1699..102

1700 – 1709..22

1710 – 1719..38

1720 – 1729..89

1730 – 1739..56

1740 – 1749..82

1750 – 1759..92

1760 – 1769..205

1770 – 1779..294

1780 – 1789..477

x – Clow & Clow p.2

LIVERPOOL LECTURES:[x]

	1840-1	1843	1845	1847	1848	1849
Physical Science.........34		13	24	36	25	32
Mental Science.........12		9	--	11	4	10
Literature & Education.........13		34	23	26	37	29
Fine Arts.......15		6	14	6	8	4
Music and the Drama.............16		18	19	8	8	14
TOTAL.............90		80	80	87	82	89

x - Hudson 1851 p.101

Some Indication of Social Position For Individuals of Note - As Per

<u>*The Dictionary of National Biography*</u>

Anderson, John
 1726 - 1796
 natural philosopher
 educated at Stirling
 professor of oriental languages and natural
 philosophy - University of Glasgow

Arbuthnot, John
 1667 - 1735
 Doctor
 son of Stottish clergyman
 educated at Aberdean
 FRS
 physician to Queene Anne

Awkwright, (Sir) Richard
 1732 - 1792
 industrialist

Babbage, Charles
 mathematician and scientific mechanician
 son of a banker
 educated at Trinity College, Cambridge

Bacon, (Sir) Francis
 1587 - 1657
 judge
 son of a 'gentleman'

Ball[e], William
 d. 1690
 astronomer
 son of aristocracy

Banks, (Sir) Joseph
 1743 - 1820
 Educated at Eton & Oxford
 President of Royal Society

appendix f - cont.

Baskervill, John
      1706 - 1775
      printer - industrialist

Bathurst, Ralph
      1620 - 1704
      president of Trinity College, Oxford
      Dean of Wells
      M.D.
      FRS

Bentham, Jeremy
      1748 - 1832
      educated at Queen's College, Oxford

Birkbeck, George
      1776 - 1841
      M.D.
      Educated at University of Edinburgh

Boulton, Matthew
      1728 - 1809
      engineer - industrialist

Boyle, (Hon.) Robert
      1627 - 1691
      natural philosopher and chemist
      son of Earl of Cork
      educated at Eton

Brougham, Henry
      1778 - 1868
      Baron
      educated at University of Edinburgh

Cavendish, Henry
      1731 - 1810
      natural philosopher
      son of Duke of Devonshire
      educated at Cambridge

Dalton, John
      1766 - 1844
      chemist, natural philosopher

Darwin, Erasmus
1731 - 1802
physician
educated at University of Edinburgh
M.B. - Cambridge

Day, Thomas
1748 - 1789
educated at Corpus Christi College, Oxford

Davy, (Sir) Humphry
1778 - 1829
chemist

Edgeworth, Richard
1744 - 1817
son of a bishop
educated at Trinity College, Dublin & Corpus
Christi College, Oxford

Goddard, (Dr.) Jonathan
1617 - 1675
educated at Oxford and Cambridge

Gresham, (Sir) Thomas
1519 - 1579
educated at Cambridge
founder of the Royal Exchange
advisor to Henry VIII and Elizabeth I

Haak, Theodore
1605 - 1690
Calvinist
educated at Oxford and Cambridge

Herschel, (Sir) John
1792 - 1871
astronomer
educated at Eton and St. Johns College, Cambridge

Joule, James
1818 - 1889
physicist
son of a brewer

appendix f - cont.

Keir, James
    1735 - 1820
    chemist
    educated at University of Edinburgh

Newton, (Sir) Isaac
    1642 - 1727
    natural philosopher
    educated at Cambridge

Oldenburgh, Henry
    1615? - 1677
    educated at Oxford
    Master of Theology

Pepys, Samuel
    1633 - 1703
    educated at Cambridge

Percival, Thomas
    1740 - 1804
    educated at University of Edinburgh
    from a merchant/commerce family

Petty, (Sir) William
    1623 - 1687
    political economist
    educated at Oxford
    Ph.D. - physics 1649

Place, Francis
    1771 - 1854
    politician and political theorotician

Priestly, Joseph
    1733 - 1804
    educated (LL.D.) at University of Edinburgh

Rooke, Lawrence
    1622 - 1662
    astronomer
    educated at Eton and Cambridge

appendix f - cont.

Smeaton, John
    1724 - 1792
    civil engineer
    FRS
    related to Thomas - leader of Scottish Reformation

Ure, Andrew
    1778 - 1857
    chemist - scientific writer
    educated at University of Glasgow and of Edinburgh

Wallis, John
    1616 - 1703
    mathematician
    son of a clergyman
    educated at Cambridge

Watt, James
    1736 - 1819
    engineer - industrialist

Wedgewood, Josiah
    1730 - 1795
    potter - industrialist

Wilkins, John
    1614 - 1672
    bishop of Chester
    educated at Oxford

Wren, (Sir) Christopher.
    1632 - 1723
    architect
    educated at Oxford

Young, Arthur
    1741 - 1820
    agriculturalist - author
    son of a champlain

Front piece from inaugural issue of *Mechanics' Magazine* / 1823. Note the nominal references (on the pillars) to individuals from the Lunar Society, The Royal Institution, & the Royal Society.

NOTES:

CHAPTER ONE

INTRODUCTION - PROBLEMS AND METHODS

1) *Nature* 1870 - Quoted in Margaret Gowing, 'Science, Technology, and Education: England in k870', in *Oxford Review of Education* 4 [1978], p.3

2) Charles Babbage, *Reflections on the Decline of Science in England*, B. Fellowes, London, 1830, p.3

3) David Suzuki at PAPT Conference, 13 November 1981, Montreal. Here 'industry' also includes medicine and the military.

4) This concept was, for example, central to the sociology of Max Weber.

5) Harold Silver, ' Aspects of Neglect', in *Oxford Review of Education* 3 [1977], p.66

6) See, for example, C.P. Snow's 'Two Culture' Rede Lecture.

7) Evidence of the latter can be seen in the resurgence of 'Futurist' study groups. See (e.g.) A. Toffler's *Learning For Tomorrow*.

8) A.R. Hall, *The Scientific Revolution*, Beacon Press, Boston.

9) See D.S.L. Cardwell, *Turning POints in Western Technology*, Science History Publications, New York, 1972

10) See for example, Jurgen Habermas, *Toward A Rational Society*, Beacon Press, Boston, 1968

11) See the work of B.F. Skinner.

12) Silver, op.cit., p.62

13) See, Habermas, op.cit., or the writings of the Frankfurt School.

14) Morris Berman, *Social Change and Scientific Organization*, Heinnemann Educational Books, London, 1978, p.XII, my italics.

15) Karl Popper, *Objective Knowledge*, Oxford University Press, London, 1979

16) Asa Briggs, in Briggs and Saville, 'The Language of Class in Early Nineteenth Century England', p. 47 - 52.

NOTES:

CHAPTER TWO

THE TRANSMISSION OF IDEAS:
(COFFEE-HOUSES, CLUBS, AND THE PRESS)

17) Quoted in Thomas Kelly, *A History of Adult Education in Great Britain*, Liverpool University Press, Liverpool, 1962, p.55

18) Allan Janik and Stephen Toulmin, *Wittgenstein's Vienna*, Simon and Schuster, New York, 1973, p.47

19) Kelly, 1962, op.cit., p.54

20) David Allen, in his article entitled 'Political Clubs of Restoration London', (*Historical Journal* 19 [1976], p.562) states that the word 'club' is younger that the practive of clubbing. Not until late in the 18th century was there any need to define the word in strict or exclusive terms, so that, in 1755, Dr. Samuel Johnson could still pronounce a club to be 'an assembly of good fellows, meeting under certain conditions.'

21) W. Hutton, *An History of Birmingham*, Pearson and Rollason, Birmingham, 1783, p.135

22) Ibid., p.135; Plumb, op.cit., p.32; and T.S. Ashton, *The Industrial Revolution 1760-1830* , Oxford University Press, London, 1961, p.127

23) Plumb, 1979, op.cit., p.32

24) Berman, op.cit.

25) Kelly, 1962, op.cit., p.99

26) Ibid., p.53

27) Roderick and Stephens, 'Nineteenth-Century Ventures in Liverpool's Scientific Education', in *Annals of Science* 28 [1972], p.61; and Plumb, 1972, op.cit., p.14

28) Robert E. Schofield, *The Founding of the Lunar Society of Birmingham 1760-1780: Organization of Industrial Research in Eighteenth Century England* , Unpublished Doctoral Dissertation, Harvard University, 1955; and Roderick and Stephens, 1972, op.cit.

29) Plumb, 1972, op.cit., p.16

30) E.J. Hobsbawm, *The Age of Revolution* , Cardinal Books, London, 1962

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72) The content and number of existing cheap literature
during this period was extremely extensive and
varied. Below are listed, merely as example, some
of the more noteable:

The Rights of Swine	*Lloyd's Penny Weekly*
Two-Pence Worth of Hogs	*Lloyd's Penny Atlas*
The Co-Operator	*Lloyd's Penny Sunday*
The Poor Man's Guardian	*Times*
The New Moral World	*The Beehive*
The Penny Magazine	*Reynold's Political*
The Penny Satirist	*Instructor*
The Odd Fellow	*Gentleman's Magazine*

For example, *The Co-Operator* was concerned with self-
instruction, *The Penny Magazine* was a Whig publication
and was pseudo-scientific (e.g. 'how many humps are
there on the back of a dromedary – dear me, how
instructive!'), and the *Gentleman's Magazine*, part of
whose policy it was, to publish 'every new invention
and improvement in every useful art'. Other popular
publications were:
> *The Annual Register*
> *Black Dwarf*
> *The Republican*
> *Aris' Birmingham Gazette*
> *Manchester Herald*
> *Liverpool Mercury*
> *Edinburgh Courant*
> *Manchester Mercury*.

It is noteworthy that subscriptions, such as those
of the *Penny Magazine* and the *Penny Encyclopedia*,
reached one million and seventy-five thousand
respectively.

73) See Silver, 1975, op.cit; Simon, 1965, op.cit.;
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78) John Donne, lines 203-205, 'The First Anniversary',
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79) Briggs, op.cit., p.2

80) Thackray, op.cit., p.673. See also Jacob Bronowski,
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81) J.W. Adamson, *Pioneers of Modern Education: 1600-1700*,
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82) Baumer, op.cit., p.47; and Hill, op.cit., p.207

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THE PROVINCIAL SOCIETIES AND THE ROYAL INSTITUTION

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120) This presents an interesting early occurance of
what Karl Popper has repeatedly denounced as being
problems in methodological naturalism - especially
in his *The Poverty of Historicism* . It is similarly
argued, in the edited work by Gary Gutting -
entitled *Paradigms and Revolutions* - that the work of

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Thomas Kuhn has been similarly mistreated in a
wide variety of fields, resulting, not only in a
misapplication of Kuhn's philosophy of science,
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133) *Memoirs of the Literary and Philosophical Society of
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136) Samuel Smiles, *Lives of Boulton and Watt*, John Murray,
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138) Ibid., p.360

139) See especially Ibid., Musson and Robinson, op.cit.

140) Berman, op.cit., p.5

141) Ibid., p.71

142) Ibid., p.8, 50; and Fritz Redlich, 'Science and
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provincial culture and scientific assocaitions

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144) Berman, op.cit., p.15-16. It is noteworthy that
     there were a total of seven 'Royal Institutions' -
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     Cornwall, South Wales, and Cork.

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149) Ibid., p.XXIII

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CHAPTER FIVE

THE MECHANICS' INSTITUTE MOVEMENT

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156) Thackray, op.cit., p.682: See also J.F.C. Harrison, *The Early Victorians, 1832 - 1851*, Weidenfeld and Nicolson, London, 1971; Lawson and Silver, op.cit.; Silver, 1975, op.cit.; Kelly, 1962, op.cit.; Plumb, 1972, op.cit.; Janik and Toulmin, op.cit.; Cotgrove, op.cit.; Roderick and Stephens, 'Approaches to Technical Education in Nineteenth Century England: Part IV - The Liverpool Mechanics' Institute', in *The Vocational Aspect of Education* 25 [1973]; D.J. Rowe, 'Class and Political Radicalism in London, 1831 to 1832', in *The Historical Journal* 13 [1970]; Alexander Tyrrell, 'Class Consciousness in Early Victorian Britain: Samuel Smiles, Leeds Politics, and the Self-Help Creed', in *The Journal of British Studies* 9 [1970]; and Ray Porter, 'Gentlemen and Geology: the Emergence of a Scientific Career, 1660 - 1920', in *The Historical Journal* 21 [1978].

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162) Roderick and Stephens, 'National Attitudes Towards
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177) meaning 'Conducive to Useful Knowledge'

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199) Harrison, 1965, op.cit., p.62

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