The Secondary School and The Needs of Industry

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Introduction

Before I begin to read my paper I should like to make two general observations.

The arguments developed in my paper apply, I believe, with equal force both to European and African secondary education. Differences of linguistic and social background in pupils call for considerable differences of curriculum at the primary school stage but much less at the secondary stage.

Then the setting up by the Copper Companies of an Educational Trust for the Copperbelt, which will lead to intensive development there, should also provide the occasion for a certain degree of educational experiment. In particular the Trust is to be concerned with the building up of four new secondary schools and I should personally like to see carried out in one of them, some of the ideas for the development of a greatly simplified and unified secondary school curriculum, which I put forward in this paper.

The Needs of Industry

Human institutions of all kinds adapt themselves only slowly to the changes which the fertile minds of scientific research workers and inventors produce in human affairs. This is rather dangerous in a time of rapid change like the present. The children who enter a secondary school at the age of twelve should be educated for the kind of society which they will enter as adults some eight years later. Yet too often they are prepared for the kind of society which their teachers regarded as normal eight or more years ago.

Looking, therefore, into the future, I believe that industry will increasingly want to recruit from the schools three different types of entrant. First of all there will be the prime need for an increasingly large group of scientists and technologists; secondly there will be a need for a group of individuals whose talents lie with people rather than with things—the kind of individuals needed by departments of welfare and information, of sales or personnel; and thirdly there will be the group destined ultimatley for managerial posts.

The main question which I want to ask today is whether the secondary schools of our generation are producing these in sufficient quantity, and with the right kind of educational background.

The Two Industrial Revolutions

In the first Industrial Revolution, chemical energy applied to many aspects of life a multiplying factor of 10. Speed of travel increased from 6 to 60 miles an hour on the average. The machines operated by chemical energy rendered the labour of 9 men redundant out of every 10. In industrial societies the average payment to the labour force was multiplied by 10 so that the worker who in 1850 earned £50 a year, by the end of the century was earning nearly £500 a year.

Atomic energy is at least 100 times more powerful than chemical energy. This means that we may expect normal speeds of travel to advance from 60 miles an hour to 6,000. Already, today, on the testing grounds of the Bristol Aeroplane Company, a passenger aeroplane can travel at 2,500 miles an hour, and the use of atomic reactors to drive ships and aeroplanes is in its very early research stages only. Also there are electronic computors that render not 99, but 999 workers out of 1,000 redundant. Theoretically, in a country whose industrial plants had made full use of atomic energy and automatic machinery, normal incomes of £50,000 a year would be possible or alternatively the standard of life of a man earning £5,000 a year could be combined with the rich creative leisure possible to a population working on the average only one day in ten.

The Need of Scientists and Humanists

These may all seem day dreams, but so would the world of 1950 seem a day dream to a man born in 1850. On the most sober estimate, if our secondary schools can increase the supply of scientists for research and technologists for industry, such day dreams might become commonplace realities. I use the word " might " deliberately, because, as we all know to our cost, the great gifts which scientific research so prodigally makes available can be used either creatively or destructively. Even within the restricted ambit of industrial activity, increased productivity depends today as much upon the human skills available to industry as to the scientific. Scientific obstacles give way to patient study, but human obstacles are not so easy to overcome. Material things can be reassembled and recreated, but human nature often stays obstinately unredeemed. So industry needs not only scientists, and technologists but those trained in the humane studies; humane in the sense that through them individuals rise to the great potentialities of the human mind.

Those in industry who are most likely to find the solution to its human problems should have had their human sympathies

kindled and their imagination developed by the great European humanist tradition in education, and this is a tradition that is centred on the study of language and literature.

The Need of Managers

One of the most careful studies of the effects of automation when applied to a power plant was carried out in the United States of America by a research team from the University of Michigan. Their report shows that as this process is applied so there arises a need for a larger and more responsible managerial group in the plant. In the first place there is a new kind of centralisation of functions; in the second place management must educate operators to learn new things and acquire new skills on the job because their jobs have to be redesigned; and thirdly the routine worker is replaced by the much more highly skilled operator or engineer so that with increase in the number of skilled craftsmen employed the quality of management called for is higher.

There are few managers of genius, just as there are few violin players of genius; but there is a wide range of managers and violin players whose performance might have been much better if they had received the right kind of education. The manager today works at a time in history when society is in a state of flux and social philosophies are rapidly changing. His sense of the eternal verities must be strong and he can best acquire this if his *historical* perspectives are sound. Industrial workers today are often frustrated in their work and seek security and social cohesion in the crowds at the cinemas or sports stadia because there they can, by identifying themselves with the actors or players, come vicariously to have a sense of meaning in life. Men, quite ordinary fallible men, want to serve their fellow men in work and in doing so to find fellowship. They will find this in their work only if those in positions of leadership in industry are aware that the objectives of an enterprise must not be set just in terms of profits, for this tends to exacerbate the tension between management and labour; nor should they be set in terms of production alone, for the aim of an industry is not to sell what a plant produces but to produce what a market needs; so, the objectives of an enterprise must be formulated in terms of the needs of individuals and of groups and finally of a whole political society. Where can the potential managers find the understanding to give this kind of leadership as well as meet the hour to hour demands on their powers of decision and executive action? I believe that they may be the sort of people who give this leadership if, at school. in a course of ' social studies ' of which the historical must be at the centre, they have grown to have a sense of the right priorities, of true perspectives and a true sense of values.

Over-specialisation in the School

In the universities of Russia and China they turn out 100 graduates in Science and Engineering to every non-scientist. In the non-Communist world, in most universities, the proportions are one to one. There is thus in the free world a relative and an absolute shortage of scientists and technologists. The main reason is that the degree of specialisation in secondary schools is such that it is virtually impossible for a student who has *not* specialised in science to *begin* these studies at the university. This was not always the case. Forty years ago I began my studies of physics at the university after qualifying for a university history scholarship at school. Professor Mott, the present Head of the Cavendish Laboratory at Cambridge, also began his study of physics at the university.

Today, the potential scientist goes up to the university after two or three years of intense specialisation in science, whilst the historian or linguist equally goes up after so specialised an education that it is virtually impossible for him to do anything at the university but to continue his school specialism. The choice between science and any other subject of study is made far too early in a student's career and this certainly means that many potential scientists are lost to the free world that needs them so badly.

Sir Lawrence Bragg, lately the Director of the Cavendish Laboratory, Cambridge, writes that " both school and university teachers of science feel that we have somehow become involved in a system that is forcing us, against our desire, to make specialisation in education both too intense and too premature. We have not yet reached agreement that arts and science are equally important components of a good education, though I think a strong case might be made out for their being so."

The Unity of Knowledge

No one could deny that the unity of knowledge, as it was understood by the educated Greek of the fifth century B.C. or the mediaeval scholar of the thirteenth century, has been broken and lost within the last fifty years. There are historical explanations of this. The tremendous increase in all branches of human knowledge is one; the need of the modern world for specialists is another. The secularisation of the institutions of learning in the seventeenth century, the broadening of the field of knowledge by the encyclopaedists of the eighteenth century, and the rift that grew up in the nineteenth century between science and letters are also partial explanations.

In the present century, in the universities particularly, there is a growing awareness of the weakness produced by these divisions and many tentative efforts have been made to develop a new unity of knowledge. One example of this is the attempt to break down the old rigid division between the Arts and the Sciences, for it is realised that it impoverishes both, so that in a modern university the Arts studies tend to become conservative and sterile whilst Science studies are narrow and divorced from human purposes. Not a scientist, but a Professor of English, Professor Dobree, has written of Arts' faculties that the " sterile scholarship there is continually grubbing up new but unimportant facts." He goes on: "At present, especially in the Arts' Faculties of provincial universities where most of the students are destined to be teachers, there is, broadly speaking, no end. It is a circular process. The student learns a subject, in order that he may teach that subject, in order that the subject may continue to be taught. It is largely a self-contained system making little impact on the outer world, and hardly affected by it: almost divorced from life, such influence as it has is a deadening one."

At the same time, in Science, the advancement of knowledge is often thought to exist wholly in discoveries of fact. Divorced from a concern for human values and purposes, the advancement of scientific knowledge may be positively dangerous to the spirit of man. The scientist may become like the man who puts on dark glasses so that he is able to see the sun, but who keeps them on when he looks at his friends and so fails to see human issues as they really are.

Disciplined to respond to a limited area of the non-personal, emotion and spirit may become atrophied in the scientist through disuse. The danger also exists that the scientific planner in a Welfare State will try to manipulate people like things. To be ignorant of the adventure of mankind with all its warnings and encouragement, is to be ignorant of man and his immortal creations; it is to produce a specialist who knows everything about his subject except its ultimate purpose and his place in the cosmos.

The school carries large accretions from the past. Rhetoric and dialect hardly exist in the old form, but Grammar and Latin do. To this curriculum the Humanists added Greek, Mathematics, Science and Music. Then the great reforming headmasters of the nineteenth century added the modern studies of History, Geography and Modern Languages. Later the Sciences fought for recognition, until Physics, Chemistry and Biology became established depart-

ments. With the development of subject specialisms, a few of the older and basic studies like English, Religious Knowledge and Physical Education, which had previously been dealt with in a general way, became new, departmentalised and competing specialisms. No human child could follow all these specialist teachers along their separate paths, and so the false and unreal division of humanist and scientific studies grew up to simplify the crowded scene.

The way out of this terrible jungle is to simplify and unify the curriculum of the secondary school in terms of *three basic* studies and disciplines *only*, which *all* children should follow in an equal and balanced way until they leave school. This would mean that at that point, but no earlier, they would be ready to follow a course at a university that might be in the specialist groups of the scientific, or the linguistic, or the social sciences, and so to follow a career in industry that might be in the fields of technology, or personnel work or of management. These three types of training must now be looked at more closely.

The Training of Scientists

The language used by scientists is the language of mathematics. It is a language like words, yet in Western Europe we have largely deprived our children of any knowledge of all but its elementary skills, because it has come to be thought of as a specialist study for a few gifted children. If a child does not study science at school, this is a loss that can be made good later at the university, provided he has studied mathematics at school, but not otherwise. The study of mathematics requires many years of disciplined, patient study and if this is not done during the years of school life the loss is nearly always permanent. The Head of the Cavendish Laboratory at Cambridge learnt his Physics at the university and not before; but this was only possible because, at school, he had thoroughly acquired the knowledge of the language and skill of mathematics. The plea will be continually made in this paper that mathematics, like language, should be one of the basic studies for *all* children during the *whole* of their school careers and that, for example, admission to a university should rest on a high performance in the use of both skills of mathematics and language. The Greeks knew perfectly well how essential it was for the educated man to be both a mathematician and a scholar of ' letters,' but curiously enough, in this most scientific of epochs, we have forgotten this truth.

As a study which essentially links the practical and the abstract there are two approaches to it. Some children seem to be bad at mathematics because they really need the practical and empirical

approach and are given the abstract and logical. They should come to mathematics from their realised need of it to measure the kites or boats they make, or to calculate the area of a table cloth. Others enjoy the sheer imaginative delight of playing with numbers or symbols that have no necessary relevance to any practical situation at all. Both approaches should be used in teaching children because both approaches are necessary in the use of mathematics in science and technology. A clear example of this can be taken from the field of aerodynamics. Many problems relating to the flight of an aeroplane can be solved by dividing them into two groups; one group relates to the forces of ' lift ' which raise an aeroplane up vertically from the earth; the other group relates to the forces of ' drag ' which tend to stop the aeroplane from moving horizontally forward. In calculating ' lift ' the theoretical physicist is needed who can quickly idealise his problems by inventing, for example, an ideal atmosphere free of internal friction. In calculating ' drag ' the applied physicist is needed who can measure real velocities in a wind-tunnel and develop empirical formulae. Together, the theoretical and the applied physicist can solve almost every problem of flight; separately they can solve only a few.

If mathematics is to be studied right through the secondary school its present treatment will need much modification. Geometry is generally begun too soon, for example, and trigonometry too late. And at every point mathematics should be related to science. In the junior forms of the secondary school children are realists, full of curiosity about the world of nature, anxious to know how all kinds of machines work and with very vivid imaginations operating in the field of space travel. Once these interests are engaged they will collect and tabulate facts without number. It is out of such curiosity and fact-finding that slowly the disciplined study of science will grow. To observations and expeiments made by the pupil the science teacher can add facts derived from his own experiments, and the knowledge of the work of painstaking or heroic scientists, so that slowly the pupil can come to know of the methods, discipline and attitude of the scientist. This understanding, through personal experience, of the nature and value of scientific method is very much more important than the knowledge of a great number of scientific facts. This combination of thorough, vigorous mathematical study, with a wide survey of the field disclosed by modern science will be the best training for future research workers as well as for the larger army of scientists and technologists needed by industry.

The Training of Personnel Workers

If the scientist, as I have argued, needs imagination in his

studies then the future worker in industry, whose sphere of work lies in human relations, needs even more two qualities of mind that are best developed in what are generally called the humane studies of language and literature. These two qualities are a steady determination of the will directed towards fellowship, and a sympathetic imagination to understand how other people think and feel. The growth of these qualities is developed best as children respond to great literature. The key to the study of literature in a school is the possession of a good library and the development of activities which force children to use the library in the same way as scientists use the laboratory. *A large supply of books and little formal* teaching will be better than the normal practice of much teaching based on a few text books. A rich supply of books, chosen carefully, together with the assistance of the kind of teaching which helps pupils to get the marrow from a treatise, or which sets pieces of research, involving the consultation of several volumes, is the best way of using a good school library. The use of books, the direction of reading, the opening up of new horizons and the wide discussion of topics related to reading—these are all the kinds of activities that are essential to the study of literature.

The choice of books for a library is also important. Mr. Hutchings, the President of the University of Chicago, thought that a university could provide a complete and liberal education if it ensured that during a period of three years an undergraduate read, understood and appreciated the hundred Best Books in the English Language. A similar choice to that made in Chicago needs to be made at a suitable level for all secondary schools where English is the language of instruction.

These literary studies in the English language will be a delight, and recreation, or if they are not they will be a failure. They should all be carried out at first in the mother tongue; but this work will be greatly enhanced if it goes side by side with the study of the language and literature of at least *one foreign language*. Many reasons have been adduced for making this a living language like French or Russian. Those gifted in the study and use of languages may indeed be able, during the six years of secondary education to encompass the study of two foreign languages; in which case there is everything to be said for an ancient and a foreign language; but for everybody, whether gifted or not, having in mind the use of language and literature as a training for human understanding and social creativeness, the best language for study is Greek, because it is the language of an incomparable literature.

English literature is surpassed by none, but its defects are at points where Greek is strong. Greek is simple and it recalls us to the central interests of the human heart. Greek truthfulness is a challenge to see the world as it is without the falsities of sentiment. Greek beauty is a challenge to our age which has multiplied ugliness faster than beauty. There have been times in human history, such as at the Renaissance, when men had to turn back to Greek literature and steep themselves again in its liberating power. There are many signs that the pulses of thought set going at the Renaissance have come to an end and once again we may need to return to a literature that held a true balance between Scientific and Humane studies.

It may be argued that this proposal to reintroduce Greek into schools that have thrown it out is a reactionary proposal. But to argue so is to misunderstand completely the new way of dealing with the subject. The object is not to produce Greek linguists, but human understanding. The essence of the new treatment of Greek is to regard it as primarily *a literary study* and only to give sufficient linguistic instruction to enable the spirit of Greek literature to be caught; since much but by no means all can be grasped through translation. There will be much study of Greek literature in translation, but if this were the only study its purpose would not be achieved. A quite new approach is needed to this kind of literary study and, for this, classics teachers will have to be retrained and also teachers of English whose classical knowledge is faint will have to have it deepened.

From the first moment of introduction to the Greek world, in the poetry of Homer, we know we are face to face with a people of genius, whose intellectual gifts are matched by their sense of beauty, and whose interest in all things human is balanced by a noble vision of the rule of law and the order of the physical universe. Athens was about the size of Salisbury. Yet that small Athenian community exercised an intense influence in every aspect of human creativeness during all the ages that followed. They were a moral people. The greatest sin was "hubris"—overmastering pride and self-conceit—for the man who succumbs to "hubris" destroys the harmony of nature. This is this lesson of the Greek dramatists. The Greek mind could not tolerate the idea of the disorderly—and their desire for order led them to search for it in the study of Science, in the development of law and the creations of Politics. So it came about that the Greek world gave to mankind the three great ideas of the rationality and intelligibility of the

universe; of the supremacy of the moral order; and of the free, responsible citizen, participating in a political society based on law. The study of these ideas and this thought is an incomparable study for those whose work is in industry to be mainly concerned with individuals and their association together in working teams. What I am proposing therefore is a new subject called Literature, which includes the study of both Greek and English literature and its roots in Language.

The Greek experiment was extinguished in bloodshed, and in Greek thought there was one serious flaw. Amid all their incomparable philosophy they produced no philosophy of history; rather a sense of ' fate,' of the sense that man's brief and uncertain existence is overshadowed by relentless forces and of the power and force of pre-determined laws. To find a profound philosophy of history and a sense that history traces the pattern between what is conditioned and what is the result of man's free decision, we have to go to the people of Jewry, who were the first to belive that history has meaning and that its meaning was contained in the destiny of thier own race, and then to the long story of the Christian Church. But this brings me on to the question of the education of managers.

The Training of Managers

Those who are destined to enter the managerial group in industry must have studied mathematics and science as well as those linguistic and literary studies that have already been described. But in addition, if the gifts of character needed in the manager are to be enhanced by knowledge, there is a third group of studies that must be added to complete this modern Trivium. This is a group that I term the ' Social Studies,' with History as its centre and core.

Another example, in addition to those already given, of the present excessive specialisation in the secondary school curriculum is shown in the way in which the subject departmentalism of the so-called ' subjects ' of Geography, History and Religious Knowledge impoverishes the whole field of the study of human society. Geography, as a set subject, would have no place in the simplified curriculum I have begun to describe. There is much that is taught in geography lessons that would be better taught as part of science; geology, astronomy and the scientific study of climate are typical examples of this kind of geographical knowledge. A good deal of the encyclopaedic collection of place-names and facts that are learnt only to be quickly forgotten might be omitted altogether. A certain amount of associated factual knowledge could be absorbed

incidentally as a part of the study of the literature of travel, exploration and adventure. A book like J. Hemming's " Mankind Against the Killers," the dramatic account of the work of the World Health Organization in four continents, is an excellent example of vivid human writing, teaching more world geography than many school text books which take this as thier title.

The main ingredient of this new subject of social studies would be History; but not History as at present taught, or as required for the General Certificate of Education. T. S. Eliot, the dramatist, has spoken of the dreary history he learnt at school. For him, he has said, history meant the ' little grey books of notes ' which enabled him to answer examination questions. What sort of questions? Here are two taken from a recent General Certificate paper:—

1. To what extent did Austrian policy affect the course of the War of the Spanish Succession?

and

2. What difficulties confronted James I on his accession to the throne in 1603?

This is adult, scientific history; the history of cause and effect, of analysis and synthesis; scientific, factual and political, instead of the romantic, ethical history children really need.

Miss Madely in her book " History as a School of Citizenship," writing as a teacher of long experience, says of history: " Its factors are too complex and too difficult for isolation and abstraction; and it demands too much initial grind to be a facile starting place for originality in imagination and creative expression. Science will serve the one purpose better, and Literature the second."

It was Whitehead, the scientist, who saw clearly the way in which History should be learnt when he wrote: " Moral education is impossible without the habitual vision of greatness." To see visions of greatness we must learn history in a certain way—the ethical, romantic way; not as outlines, or cause and effect, or developing economic and political structures, but as the record of the best things that have been done and suffered and written in the world. This means primarily a study of the makers of civilisation; of the men of action like Charlemagne, Lincoln and Churchill; and of men of thought like St. Francis, Faraday and Schweitzer; and of men of vision like Plato, St. Augustine and Pasteur. Such a study is by no means mere biography, for it will also include the stories of those crucial periods in history when forces of good and evil were in conflict, such as the exodus from Egypt, Pericles and Peloponnesian War, and the abolition of Slavery in Africa. It will

include selections from the Bible, Shakespeare and Burke; from great speeches by Lincoln, Masaryk, and Roosevelt; from novels of Austen, Dickens and Kipling; from ballads, epics and poems; from all those sources that show the greatness and littleness of man. It was such an ethical-romantic approach to History which gave to the work of the Scandinavian Folk High Schools the dynamic power which made them the strongest force in social betterment, changing a whole people in Denmark from a torpor like death into one of the most intelligent and farming communities in Europe.

In such a study, when it touches the history of the country of their birth, children may forget the causes of the War of the Spanish Succession or the difficulties of poor James I and remember of their country only, as Thucydides said, " that her greatness was won by men of courage who laid their powers at her feet as their fairest offering."

Much of this history will be what is generally called ' secular ' history and some will be the kind of ' religious ' history that is often studied under the title of ' religious ' knowledge. Just as the separation of mathematics and science is to be deplored and also the separation of English and Greek, so in the third branch of the new Trivium it is not only artificial to separate ' history ' from ' religious knowledge ' but dangerous, because it implies that there are two standards of historical truth; the secular standard which is critical and the religious standard which is credulous.

Take the story of the Jews, for example. Like the story of the Greeks, it is unique in the story of the development of Man. It has been this race, obstinately separate, that has clung to deep insights into man's nature and destiny. A long line of austere prophets culminating in the greatest of all, Christ, declared this vision continually, and no other people has reached such an insight of a living God, who is creator and Father of mankind; and of human history as a drama unfolding both in Time and in Eternity and leading human history to a climax and a conclusion.

This story and this philosophy must form the central theme to school history as it is projected forward into the history of Christianity and the work of the Christian Church in the world. This is the story and this is the historical thread that should be central to all history teaching, for it gives meaning to all the rest; to the building of Europe out of brute materials into the social order of the Middle Ages, through the conversion of kings, the setting up of bishoprics and the founding of monasteries—to the loss of unity

in the sixteenth century, the growth of nationalism, the conflict between monarchy and parliamentary government, the rise of the secular state and of new economic empires—all leading on to a discovery of meaning in the age of nationalism, of dictatorship and of nascent world government in which we live today.

In school history as it has been taught in the past, the story generally stops some decades short of the present day because it is thought that contemporary history is uncertain. But in social studies, as I have sketched it, it is essential that the lessons of the past should be applied to the present and that an important part of this work should be the study of contemporary affairs. It is essential that something should be seen and evaluated of both the vitality of nationalism and of its potentially destructive power; of Marxism as a deterministic creed become a gospel of revolution, that puts in peril all philosophies derived from the fundamental Christian beliefs in man as a free agent, morally responsible for his neighbour and set upon earth to remould human society nearer to the ideal of a Kingdom of God.

These are the studies I believe will give particularly to the potentail manager the power of moral judgement, the sense of priorities and the purposeful drive that his avocation demands.

The New Trivium

My thesis then is that, as the second Industrial Revolution gathers momentum, there are three types of individual who will be needed in industry—(1) scientists; (2) administrators and personnel workers; and (3) actual or potential managers. Corresponding to these three needs, a new unified Trivium is required in the curriculum of the secondary school. In the new Trivium that I propose much has been cast out from the present secondary school syllabus, particularly the accumulation of inert scientific or non-scientific facts. Instead, the emphasis has now been placed on the acquisition of the mathematical and linguistic tools of learning; on the acquisition by all pupils of a scientific, and a literary and an historical attitude of mind. In place of the old load of knowledge, some old disciplines have, it is true, been put back in the curriculum—particularly those of mathematics and classics, and this may be thought by some to be too heavy a burden for the pupil of today; but let us remember that we are talking now of the education of an industrial elite, the leaders of the industry of the future. We can, for these, in simplifying the curriculum, destroy the old subject departmentalism and educate all alike in the three main departments of knowledge, of

science, of letters and of the social studies. And if we do this, then we shall no longer send into industry scientists who take a narrow, inhuman view of science, or humanists who are strangers in the modern scientific world, or historians who are without vision, but young men and women capable of depth of thought and skill in the use of man's two basic languages—words and mathematics; individuals humanised by great literature; and personalties capable of making those creative interventions which will restore a balance between man's free powers and the determinism of history; so that in the end the mundane tasks of industrial enterprise themselves will be seen to express the vision of a spiritual order.