

# Science and the Humanities

**Robert Cassen**

**W. H. AUDEN** once said that when he found himself among scientists, he felt like a curate who had strayed into a drawing-room full of dukes; this sense of a whole new world with which most of us are out of touch must often come home to someone looking at the latest piece of electronic engineering, or just hearing about new developments in nuclear theory. Miles away. Unfortunately, the feelings evoked are not always those of inferiority; quite as often, the intruder thinks of himself as an elephant in a zoo full of monkeys. However he feels, he does at least feel different; and the difference has acquired the unpleasantly final-sounding label of "The Two Cultures". The division is older than the economic needs which have forced discussion of it into prominence during the last three or four years, and so on the whole are people's opinions about it. It must be looked at chiefly as an educational problem, though in fact it involves much more than that.

What happens, in the public eye, is roughly this. An article by some qualified person appears in the *Observer*, the *Sunday Times*, the *New Statesman*, the *Listener*, or the *New Scientist*. There are two basic approaches: the economic argument—we are falling behind the U.S.A. and U.S.S.R. in the education of scientists and technologists, and we must have more of them to keep our industries competitive in world markets; and the ignorance argument—for a man to be ignorant of Einstein is as serious a failing in his education as ignorance of Plato, Beethoven, Bismarck, or Tolstoy. The first of these approaches is never denied validity, though there is a residue of wishful thinking that somehow the progress of science might be halted and we could go back to our knitting. But the implications of both for education always arouse protests: scientific education is narrow and unstimulating; only humane studies bring a true understanding of man's emotions and activities, and of the "grandeur" of existence on our planet; science is a dry adjunct of real life, useful for satisfying certain kinds of curiosity, and for providing the materials to support men in their pursuit of more important things. The scientists, secure in their more direct sense of purpose, look on these derogatory allegations with their customary tolerance.

## Science and sanity

There is some truth, and some rather ostrich-like behaviour, on both sides. Ours is a fragile and a fertile civilisation, and it has to be held together by a good deal of nervous and physical strain; with the boundaries of knowledge disappearing beyond any single person's grasp, premonitions of disaster, and rapid social change, it is the function of our educators to see that, as far as they can help it, no-one and nothing of value gets lost. None of the aims of education should be let out of sight—to put before people a "vision of greatness", to awaken their realisation of the difficulties, complexities and excitements

of the world; to create in them a sense of responsibility; and to make them "capable in their labour and contented when alone"—what sociologists call being adapted to life in the community and competent in the employment of leisure. Large, comfortable words; no-one expects that all or any of these aims can be achieved for every single individual who passes through our schools and universities; nor can it be said that the system we now have is failing to achieve them for anyone—far from it. But improvements can be made. I want to maintain in particular that an increase of scientific and technological education is important not as an unpleasant economic necessity, but as a contribution to the general sanity of society.

## Educational bottleneck

First a glance at the economic side. Here is one of the less encouraging tables:

1954 graduates per million population			
	Pure Science	Technical	Total
U.K.	105	57	162
U.S.A.	144	137	281
U.S.S.R.	56	280	336

In addition, our 9,000 medium-grade engineers with a Higher National Certificate from Technical Colleges were more than offset by the 70,000 graduates from Russian *Tekhnikums*. There is no need to advance arguments to show how essential these people are to industry; uranium fission is only 18 years old, and now look at it. But there are signs that matters are improving. The Government has finally woken up to the fact that its £26m. spent on Technical Colleges since the war (plus about £17m. under present construction) was absurdly inadequate, and plans to spend almost as much again over the next two and a half years; passes in 1955 G.C.E. 'A' level show an increase over 1950 H.S.C. of 12% in English, 18% in French, 27% in Chemistry, and 48% in Physics; and, unexpectedly, the P.E.P. study reported that technical graduates of 1950 were earning an average of £741 a year in 1954, and scientists £686, while the poor Arts men were lagging along at £654. This latter detail, however, by no means signifies that we are approaching a more rational economy in which the country pays most to the people it wants most. The low average salary for Arts graduates is partially explained by the high proportion going into teaching, while the plums to be had at the other end of the scale are still large enough to encourage too many to reach for them. The prospects for scientists as a whole though, are driving them to the emigration offices; nothing has been done to tempt them into the schools, where they are urgently needed. In fact, as long as school-teaching continues to be rewarded by vocational satisfaction and social prestige rather than material benefits, we shall all suffer for it. There is also a need for an alternative system of science degree courses, which at present condition graduates for research and industrial employment

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much more than for teaching. True, the number of teachers has been growing by 5-6,000 a year over the last five years, but most of these are on the Arts side; this is still the direction in which "potential teachers" are encouraged to go. But, assuming only a 4% annual increase in overall productivity for the future, the Committee for Scientific Manpower believes that doubling the present yearly harvest of scientists and technicians by 1970 will prove sufficient, and it must also believe it will get them.

And if it will get them, what is there to worry about? Two things; firstly, although the numbers of those reading science subjects in schools is rising, we cannot be sure that the increase involves the ablest children; there is still sufficient pro-humane bias amongst people who give educational advice to make this far from certain. And secondly, can we be content to leave open the great division between arts men and scientists? The consequences of this division are the practical reasons for wishing to close it; there are also good educational reasons, both from the point of view of the advantages of science training, and from that of the shortcomings of humane education.

### Ignorance in authority

One of the greatest dangers of the separation of the two cultures lies in the implications of the scientist's isolation. By this I do not mean his social position, though no doubt part of the reluctance of young people to become scientists, and more especially technologists, is due to the relative lack of publicity for their achievements; they rarely receive the immediate limelight which is the lot of authors, actors, musicians, politicians, generals, and even literary critics; in fact they are often seen as the servants of a society which exists for such people's glorification. But I am more concerned with the practical effects of their isolation. Apart from their role as explorers in certain fields of human knowledge, we rely on scientists and technologists for industrial, military, agricultural and therapeutic progress and continuity. They, however, are frequently in an equivocal position, in that their discoveries create forces which are going to alter our lives, while they have no authority, and often insufficient experience, to say or even to know how they are to be applied: whereas those who have the duty of applying them have no knowledge of their details or of the likely results of further discoveries. When for a man like Oppenheimer the question whether or not simply to carry on with a particular line of mathematical enquiry may necessitate a decision with immense political repercussions, it is important that those who depend on him should have some understanding of what he is doing; they must be able to share his responsibility, to grasp his frame of mind, to advise him and not just make demands on him. They do not even know what demands can be made on him—they can only take his word for it, or the word of other scientists. Again, when Macmillan announced in Parliament some weeks ago that he was "satisfied" that the proposed hydrogen-bomb test would have no grave biological consequences, what kind of reliance could be placed on his satisfaction? No-one but a scientist could challenge him with any useful authority. We may not expect politicians to have a complete mastery of the theory of genetics and radiation hazards, but it is vital for them and the public at least to realise the size of the errors scientists are capable of making in calculations of this kind. Just who is to govern whom?

Such extreme cases are not by any means the only ones in which technical knowledge would be invaluable to men who are not specifically engaged in technical occupations. In industry, for instance, the attitude of managements to their technical experts varies from that of considering them as people valuable for nothing other than carrying out testing procedures, to a vision of them as a kind of outboard-motor for the whole works. Numerous firms have made great advances as a result of their research departments, but a large number do not employ them at all, or have more than they need; and they cannot tell whether to set them up or how to make the best use of them, because they do not know what they have to gain by it. This is no doubt one of the reasons why the U.S.S.R. has no jobs in industry for clean-fingered arts graduates. Another reason is that very often financial decisions concerning the establishment of new projects and the introduction of innovations are taken by executives who have inadequate grasp of what is involved. Once more, minute knowledge of technical details is not essential, but money and time could be saved—and earned—if they had a concrete understanding of the possibilities of development of a scheme, and its liability to alteration by the impact of subsequent research. If our industries are to remain competitive in world markets, it is not only the back-room boys who need hotting up.

### God in the gaps

One final sphere—perhaps a subsidiary one—in which it is more obviously necessary to bridge the culture-gap is that in which science affects human thought. The Heisenberg principle, for instance, has been quoted by philosophers and religionists as, amongst other things, an argument for free-will, a disproof of causality, and evidence of the mysterious ways of God; considerably less misuse would be made of it if all of them knew what it actually said. It may well have serious philosophical implications, and so perhaps will future discoveries in biochemistry and in neurophysiology and brain chemistry; here again, the scientists will not be entirely competent to discuss them, while the specialists who are will have to take their information on trust and hope they have got it right.

### "Narrowness"

So much for the undesirable consequences, or some of them, of the great divide. A brief examination must now be made of what scientific education does to the mind, and why it has the reputation of being dry and narrowing. To begin with, no-one can pretend that science is easy or often delightful; we come to the study of humane subjects well prepared for the things they deal in: people, emotions, ideas, language—they are already our background, and to learn and think about them is at once to gain insight into human activities and to be partaking in them. Science is emotionally neutral; it requires the acquisition of a large body of facts and techniques, which are used to study the behaviour of matter in a very abstract way—we are always at several removes from the actual things investigated; mathematical symbols, laws, formulae, models—the things themselves cannot usually be seen at all. We are not personally moved, except perhaps in a very sophisticated way, by learning the activi-

ties of particles in the way we can be by reading a poem or a chapter of history; even discovering the mechanics of human functions does little to change one's experience of them. It may reduce mystery; for many scientists, though, the universe is more mysterious than it is for a lot of theologians and linguistic analysts.

### Selection at school

There are, then, certain unalterable facts which makes the study of science "narrow" in the way the humanes like to malign it; an unremitting diet of science is no more a complete education than its opposite extreme. But two interrelated circumstances make for an under-estimation of the interest and mind-expansion which science can generate. One of these is the way science is taught in schools—very often badly and with no attempt to arouse enthusiasm. Statements come out of the book, and boringly predictable experiments prove them boringly true; how much difference could be made simply by posing questions, and allowing children to devise experiments to answer them and to carry them out even if they will not work. This type of creative, explorative approach to teaching has been introduced here and there, but it is often dismissed as taking too much time and not producing the highest academic standards—of that later. The other circumstance is the mentality of the kind of child who is encouraged to specialise in science at an early age: usually good at mathematics, precise, and relatively unresponsive to "humane" interests. His education emphasises these qualities, and his appearance in the world emphasises the humanes' misgivings about scientific education. It is hard to believe, though, that apart from exceptional cases there really is such a thing as a ready-made scientific mentality, if only because one meets proportionately at least as many "narrow-minded" arts men as "broad" and humane scientists. But it is unfortunate that educational prejudice and the structure of society induces children with wider interests to go predominantly onto the arts side, for unless they have no aptitude for mathematics, they may well have the most to gain from science and to give to it.

### Two camps

What can, ideally, be gained from it is undeniable: discipline, clarity, and at the highest level, the satisfaction of the pursuit of truth. Besides this, at nearly all levels, most scientists will say that their knowledge of the physical composition of the universe adds considerably to their interest in and enjoyment of life; it would seem rather odd to a scientist even to have to say this, and still odder to use it as a defence of scientific education. But it seems something that non-scientists can hardly understand or accept; here they differ from the scientist, who would rarely be sceptical enough to enquire whether the humanes' knowledge of literature or history affects *their* lives. There are few limits to the amount of knowledge that people can, and most of us have to, live without; but though it may be harder to get excited about it, there is no scale on which we can rank scientific knowledge as intrinsically less valuable than knowledge of any other kind.

These remarks apply mainly to pure science; the intellectual exaltation obtainable from technological studies is possibly much smaller; and in both fields, perhaps, most of the people who study them are not primarily affected by such considerations. If this is so, there is all the more

need to examine the present over-specialised system and see what can be done to improve it.

All is not well in the humane camp. Ask 100 university arts students what they are going to do, and 95 of them will not know. The fortunate few go into politics, journalism or various cultural activities; the rest end up in commerce, industry ("the personnel side, of course") or teaching, very often, if not quite always, with feelings of *faute de mieux*. This unease arises partly because the growing number of graduates makes placing in any occupation more competitive; partly because National Service means that a man is 23 by the time he graduates and, particularly if he wants to do post-graduate work in his own subject, is unlikely to relish the prospect of spending several more years acquiring a vocational qualification; partly because he has developed a number of abilities and insights almost none of which will be utilisable in his job; and partly because he has become accustomed to a certain amount of emotional gratification in his work which very few occupations can provide. Even if these insights and this gratification really are more important than his job, he is not going to be any less apprehensive about giving up his life to it for having them.

### Arts man's malaise

A kindred uneasiness is also beginning to be felt by many arts Fellows—particularly the younger ones; one cannot tell how much this is due to a feeling that they are creating in their pupils talents which the world is not going to make use of, how much to a questioning of the value of what they are doing for its own sake, how much to a sense of insufficiency in face of the growing recognition of the importance of science. Numbers of them, at least, feel a positive need to justify themselves, especially in English, Modern Language, and History faculties, where they are sensible of a lack of discipline, and look on philology and documentary work as the bitter pill which makes up for it, encouraging them against the suspicion that the people who read their subjects are those who cannot do anything else.

This may be a slightly overdrawn picture, representing

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only the arts men's darker moments. It would be nonsensical to deny that what they are doing is important and valuable; my contention is only that, given the tempo of life in the twentieth century, and the number of different masters who have to be satisfied, a nineteenth-century educational programme, however successful in sharpening and expanding the intellect, is bound to produce misgivings if it concentrates on what is "true and lasting" in the humanities to the exclusion of scientific, technical and vocational training.

## Re-orientations

Some of the reasons for the desirability of a change of emphasis in our educational system have now been raised; all of them point to the kind of change which is needed. The country does not just want "more scientists and technologists"; it wants people capable of managing, exploiting, and living in an increasingly scientific age. This will not be achieved by a crash-programme of technical training, which will only widen the culture-gap. What is wanted is still a two-sided system in which arts and science predominate, but in which each side takes in more of the other than it does at present.

The number of late-stayers at schools has been going up by about 5% a year for the last five years, and the over-specialisation which now prevails is largely a result of the increased demand for university places; since there are less places than applicants, the universities naturally take those with the best qualifications, and since schools want their pupils to get the places, they are forced to make an early start in bringing them up to the necessary standard. Consequently, any reform of university courses must go hand in hand with changes in their requirements and in the syllabus of sixth-form work. A decision to confine specialisation to the last year of the sixth form would not necessarily involve the lengthening of university courses, since a considerable amount of school work has to be repeated in the first year at a university. Many science courses virtually require a fourth year already, and more will soon have to make four years compulsory; once the subject is envisaged on this scale, the introduction of an obligatory arts course becomes less difficult.

## Widening horizons

On the arts side, even if it is impossible to include a useful science course during a three-year degree by reducing sixth-form specialisation and cutting down unnecessary frills, the addition of an extra year to make it possible would not be a gain for the arts student in scientific knowledge alone; one can absorb more of two subjects taken parallel over a period of time than of each subject one after the other in the same period; with the abolition or reduction of National Service such a scheme will be increasingly feasible.

This is not the place for a detailed elaboration of proposed plans: not the place, because a wholesale reform of the type desired cannot be made; the time, money, energy and inclination needed to establish closer organisational contact between school and university, and to re-align syllabuses and examinations, simply do not exist. Educational reforms in this plane occur piecemeal, and chiefly by the extension of successful experiments within the existing structure. One such experiment, a "Science Greats", might well provide both the alternative degree for

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prospective science teachers I mentioned earlier, and the kind of scientific background required by industrialist or even politicians who are not going to be professional scientists—there has been sporadic agitation for such a course in Oxford for the last six or seven years, but nothing has even been done. No experiments can be devised until we decide what we are working towards, and reach a measure of agreement about it; and the details cannot be locked into place before this is done, and before two particular obstructions have been coped with.

The first of these is finance; education has always been somewhat the Cinderella of government planning, and being the longest of long-term investments, is usually sacrificed to immediate needs. Perhaps now that it is more visibly essential to our economy as well as to other branches of welfare, something will change. It is sickening that so many of the most useful educational schemes have been left to the benevolence of industrial concerns—the I.C.I. conversion scholarships, the Industrial Fund for the Advancement of Science in Schools; but it is possibly over-optimistic to expect that a government devoted to short-term raising of the standard of living will ever allot to education the proportion of the national income which its importance deserves.

The other obstruction is prejudice. Any brief discussion of education lends itself to the assertion of generalisations into which no individual exactly fits. One talks buoyantly of enthusiasm and excitement, when any schoolmaster knows that, in default of a team of physical trainers, psychologists, and passionate academics for each child, there will always be a large number to whom these

emotions, in the classroom at least, are wholly unknown. Scientists may not want to be "humanised", and humanes may hate or be bored by science. And one talks of educational ideals, when for many people teaching is, not unreasonably, just one of many ways of earning a living. But educationalists cannot stand still while any plausible resource remains untried, and it is not too sweeping to say that the inflexible attitudes of the humanes—and not perhaps exclusively the humanes—are inhibiting the adoption of many such resources.

I have maintained that an arts degree is no longer a guaranteed one-way ticket to heaven; that even from the point of view of the humane ideal, a scientific education need be no narrower than any other, and that some attempt must be made to close the gap between the two cultures. There is no reason to denigrate the value of humane studies; clearly, as we come in for our spate of leisure problems, they will be more and more important. But an increase in scientific education, if far from being a panacea, is one step towards social cohesion—a step which will not be fully taken as long as those who form and perpetuate educational opinion have only a grudging respect for the scientist and the technician. Until this resistance is overcome, until scientific training is accepted completely for its educational as well as its practical advantages, our schools and universities will go on turning out men and women who, for all their awareness of the splendour and tragedy of human life, will be less efficient and less content in their jobs than they easily could be, and very many of whom are out of date before they have even started.

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