

In fact, one had travelled much further than across an ocean—because after a few thousand Atlantic miles, one found Greenwich Village talking precisely the same language as Chelsea, and both having about as much communication with M.I.T. as though the scientists spoke nothing but Tibetan. For this is not just our problem; owing to some of our educational and social idiosyncrasies, it is slightly exaggerated here, owing to another English social peculiarity it is slightly minimised; by and large this is a problem of the entire West.

By this I intend something serious. I am not thinking of the pleasant story of how one of the more convivial Oxford great dons—I have heard the story attributed to A. L. Smith—came over to Cambridge to dine. The date is perhaps the 1890s. I think it must have been at St. John's, or possibly Trinity. Anyway, Smith was sitting at the right hand of the President—or Vice-Master—and he was a man who liked to include all round him in the conversation, although he was not immediately encouraged by the expressions of his neighbours. He addressed some cheerful Oxonian chit-chat at the one opposite to him, and got a grunt. He then tried the man on his own right hand and got another grunt. Then, rather to his surprise, one looked at the other and said, "Do you know what he's

tragic, so must the social condition be. Each of us is solitary: each of us dies alone: all right, that's a fate against which we can't struggle—but there is plenty in our condition which is not fate and against which we are less than human unless we do struggle.

Most of our fellow human beings, for instance, are underfed and die before their time. In the crudest terms, *that* is the social condition. There is a moral trap which comes through the insight into man's loneliness: it tempts one to sit back, complacent in one's unique tragedy, and let the others go without a meal.

As a group, the scientists fall into that trap less than others. They are inclined to be impatient to see if something can be done: and inclined to think that it can be done, until it's proved otherwise. That is their real optimism, and it's an optimism that the rest of us badly need.

In reverse, the same spirit, tough and good and determined to fight it out at the side of their brother men, has made scientists regard the other culture's social attitudes as contemptible. That is too facile: some of them are, but they are a temporary phase and not to be taken as representative.

I remember being cross-examined by a scientist of distinction. "Why do most writers take on social opinions which would have been thought distinctly uncivilised and *démodé* at the time of the Plantagenets? Wasn't that true of most of the famous twentieth-century writers? Yeats, Pound, Wyndham Lewis, nine out of ten of those who have dominated literary sensibility in our time—weren't they not only politically silly, but politically wicked? Didn't the influence of all they represent bring Auschwitz that much nearer?"

I thought at the time, and I still think, that the correct answer was not to defend the indefensible. It was no use saying that Yeats, according to friends whose judgment I trust, was a man of singular magnanimity. 119()-32.2113(t)4e211d9(h)3.9

Those are two of the misunderstandings between the two cultures. I should say, since I began to talk about them—the two cultures, that is—I have had some criticism. Most of my scientific acquaintances think that there is something in it, and so do most of the practising artists I know. But I have been argued with by non-scientists of strong down-to-earth interests. Their view is that it is an over-simplification, and that if one is going to talk in these terms there ought to be at least three cultures. They argue that, though they are not scientists themselves, they would share a good deal of the scientific feeling. They would have as little use—perhaps, since they knew more about it, even less use—for the recent literary culture as the scientists themselves. J. H. Plumb, Alan Bullock and some of my American sociological friends have said that they vigorously refuse to be corralled in a cultural box with people they wouldn't be seen dead with, or to be regarded as helping to produce a climate which would not permit of social hope.

I respect those arguments. The number 2 is a very dangerous number: that is why the dialectic is a dangerous process. Attempts to divide anything into two ought to be regarded with much suspicion. I have thought a long time about going in for further refinements: but in the end I have decided against. I was searching for something a little more than a dashing metaphor, a good deal less than a cultural map: and for those purposes the two cultures is about right, and subtilising any more would bring more disadvantages than it's worth.

At one pole, the scientific culture really is a culture, not only in an intellectual but also in an anthropological sense. That is, its members need not, and of course often do not, always completely understand each other; biologists more often than not will have a pretty hazy idea of contemporary physics; but there are common attitudes, common standards and patterns of behaviour, common approaches and assumptions. This goes surprisingly wide and deep. It cuts across other mental patterns, such as those of religion or politics or class.

Statistically, I suppose slightly more scientists are in religious terms unbelievers, compared with the rest of the intellectual world—though there are plenty who are religious, and that seems to be increasingly so among the young. Statistically also, slightly more scientists are on the Left in open politics though again, plenty always have called themselves conservatives; and that also seems to be more common among the young. Compared with the rest of the intellectual world, considerably more scientists in this country and probably in the U.S. come from poor families.⁵

Yet over a whole range of thought and behaviour, none of that matters very much. In their working, and in much of their emotional life, their attitudes are

class have the same labels as themselves. If I were

There seems then to be no place where the cultures meet. I am not going to waste time saying that this is a pity. It is much worse than that. Soon I shall come to some practical consequences. But at the heart of thought and creation we are letting some of our best chances go by default. The clashing point of two subjects, two disciplines, two cultures—of two galaxies, so far as that goes—ought to produce creative chances. In the history of mental activity that has been where some of the break-throughs came. The chances are there now. But they are there, as it were, in a vacuum, because those in the two cultures can't talk to each other. It is bizarre how very little of twentieth-century science has been assimilated into twentieth-century art. Now and then one used to find poets conscientiously using scientific expressions, and getting them wrong—there was a time when 'refraction' kept cropping up in verse in a mystifying fashion, and when 'polarised light' was used as though writers were under the illusion that it was a specially admirable kind of light.

Of course, that isn't the way that science could be any good to art. It has got to be assimilated along with, and as part and parcel of, the whole of our mental experience, and used as naturally as the rest.

I said earlier that this cultural divide is not just an English phenomenon: it exists all over the western world. But it probably seems at its sharpest in England, for two reasons. One is our fanatical belief in educational specialisation, which is much more deeply ingrained in us than in any country in the world, west or east. The other is our tendency to let our social forms crystallise. This tendency appears to get stronger, not weaker, the more we iron out economic inequalities: and this is specially true in education. It means that once anything like a cultural divide gets established, all the social forces operate to make it not less rigid, but more so.

The two cultures were already dangerously separate sixty years ago; but a prime minister like Lord Salisbury could have his own laboratory at Hatfield, and Arthur Balfour had a somewhat more than amateur interest in natural science. John Anderson did some research in inorganic chemistry in Leipzig before passing first into the Civil Service, and incidentally took a spread of subjects which is now impossible.⁹ Non226.761 Tm (9)-0.521877(N)--117.73((a)-0.695254(

job, while their contemporaries and counterparts in English or History will be

our practical tasks in the world. But I can think of only one example, in the whole of English educational history, where our pursuit of specialised mental exercises was resisted with success.

It was done here in Cambridge, fifty years ago, when the old order-of-merit in the Mathematical Tripos was abolished. For over a hundred years, the nature of the Tripos had been crystallising. The competition for the top places had got fiercer, and careers hung on them. In most colleges, certainly in my own, if one managed to come out as Senior or Second Wrangler, one was elected a Fellow out of hand. A whole apparatus of coaching had grown up. Men of the quality

much less accept it. Intellectuals, in particular literary intellectuals, are natural Luddites.

That is specially true of this country, where the industrial revolution happened to us earlier than elsewhere, during a long spell of absentmindedness. Perhaps that helps explain our present degree of crystallisation. But, with a little qualification, it is also true, and surprisingly true, of the United States.

In both countries, and indeed all over the West, the first wave of the industrial revolution crept on, without anyone noticing what was happening. It was, of course—or at least it was destined to become, under our own eyes, and in our own time—by far the biggest transformation in society since the discovery of agriculture. In fact, those two revolutions, the agricultural and the industrial-scientific, are the only qualitative changes in social living that men have ever known. But the traditional culture didn't notice: or when it did notice, didn't like what it saw. Not that the traditional culture wasn't doing extremely well out of the revolution; the English educational institutions took their slice of the English nineteenth-century wealth, and perversely, it helped crystallise them in the forms we know.

Almost none of the talent, almost none of the imaginative energy, went back into the revolution which was producing the wealth. The traditional culture became more abstracted from it as it became more wealthy, trained its young

The curious thing was that in Germany, in the 1830's and 1840's, long before serious industrialisation had started there, it was possible to get a good university education in applied science, better than anything England or the U.S.

THE SCIENTIFIC REVOLUTION

I have just mentioned a distinction between the industrial revolution and the

In the United States, perhaps, there is a wider nodding acquaintance with industry, but, now I come to think of it, no American novelist of any class has ever been able to assume that his audience had it. He can assume, and only too often does, an acquaintance with a pseudo-feudal society, like the fag-end of the Old South-but not with industrial society. Certainly an English novelist couldn't.

Yet the personal relations in a productive organisation are of the greatest subtlety and interest. They are very deceptive. They look as though they ought

Rutherford himself had little feeling for engineering. He was amazed—he used to relate the story with in credulous admiration—that Kapitza had actually sent an engineering drawing to Metrovick, and that those magicians had duly studied the drawing, made the machine, and delivered it in Kapitza's laboratory! Rutherford was so impressed by Cockcroft's engineering skill that he secured

of twenty-one far harder than the Americans, though no harder than the Russians. At eighteen, our science specialists know more science than their contemporaries anywhere, though they know less of anything else. At twenty-one, when they take their first degree they are probably still a year or so ahead.

The American strategy is different in kind. They take everyone, the entire population,¹⁶ up to eighteen in high schools, and educate them v

Englishman to every one and a half Americans to every two and a half Russians.¹⁹ Someone is wrong.

With some qualifications, I believe the Russians have judged the situation sensibly. They have a deeper insight into the scientific revolution than we have, or than the Americans have. The gap between the cultures doesn't seem to be anything like so wide as with us. If one reads contemporary Soviet novels, for example, one finds that their novelists can assume in their audience—as we cannot—at least a rudimentary acquaintance with what industry is all about. Pure science doesn't often come in, and they don't appear much happier with it than literary intellectuals are here. But engineering does come in. An engineer in a Soviet novel is as acceptable, so it seems, as a psychiatrist in an American one. They are as ready to cope in art with the processes of production as Balzac was with the processes of craft manufacture. I don't want to overstress this, but it may be significant. It may also be significant that, in these novels, one is constantly coming up against a passionate belief in education. The people in them believe in education exactly as my grandfather did, and for the same mixture of idealistic and bread-and-butter reasons.

Anyway, the Russians have judged what kind and number of educated men and women²⁰ a country needs to come out top in the scientific revolution. I am going to oversimplify, but their estimate, and I believe if, 6535(o)-4.5577703(6535(o)-87v

administrators, an entire community, who know enough science to have a sense of what the scientists are talking about.

That, or something like that, is the specification for the scientific revolution.²³

They had acquired immense political skill, just as we have. A good many of them were tough-minded, realistic, patriotic men. They knew, just as clearly as we know, that the current of history had begun to flow against them. Many of them gave their minds to working out ways to keep going. It would have meant breaking the pattern into which they had crystallised. They were fond of the pattern, just as we are fond of ours. They never found the will to break it.

4

THE RICH AND THE POOR

But that is our local problem, and it is for us to struggle with it. Sometimes, it is true, I have felt that the Venetian shadow falls over the entire West. I have felt that on the other side of the Mississippi. In more resilient moments, I comfort myself that Americans are much more like us between 1850 and 1914. Whatever they don't do, they do react. It's going to take them a long and violent pull to be as well prepared for the scientific revolution as the Russians are, but there are good chances that they will do it.

Nevertheless, that isn't the main issue of the scientific revolution. The main issue is that the people in the industrialised coun

The West has got to help in this transformation. The trouble is, the West with its divided culture finds it hard to grasp just how big, and above all just how fast, the transformation must be.

Earlier I said that few non-scientists really understand the scientific concept of acceleration. I meant that as a gibe. But in social terms, it is a little more than a gibe. During all human history until this century, the rate of social change has been very slow. So slow, that it would pass unnoticed in one person's lifetime. That is no longer so. The rate of change has increased so much that our imagination can't keep up.

There is *bound* to be more social change, affecting more people, in the next decade than in any before. There is *bound* to be more change again, in the 1970's. In the poor countries, people have caught on to this simple concept. Men

It is simply that technology is rather easy. Or more exactly, technology is the branch of human experience that people can learn with predictable results. For a long time, the West misjudged this very badly. After all, a good many Englishmen have been skilled in mechanical crafts for half-a-dozen generations. Somehow we've made ourselves believe that the whole of technology was a more or less incommunicable art. It's true enough, we start with a certain advantage. Not so much because of tradition, I think, as because all our children play with mechanical toys. They are picking up pieces of applied science before they can read. That is an advantage we haven't made the most of. Just as the Americans have the advantage that nine out of ten adults can drive a car and are to some extent mechanics. In the last war, which was a war of small machines, that was a real military asset. Russia is catching up with the U.S. in major industry—but it will be a long time before Russia is as convenient a country as the U.S. in which to have one's car break down.²⁵

The curious thing is, none of that seems to matter much. For the task of totally industrialising a major country, as in China today, it only takes will to train enough scientists and engineers and technicians. Will, and quite a small number of years. There is no evidence that any country or race is better than any other in scientific teachability: there is a good deal of evidence that all are much alike. Tradition and technical background seem to c

In their own internal climate, the breeze of the equality of man hits you in the face, sometimes rather roughly, just as it does in Norway.

That is why scientists would do us good all over Asia and Africa. And they

the West will have become an *enclave* in a different world—and this country will be the *enclave* of an *enclave*. Are we resigning ourselves to that? History is merciless to failure. In any case, if that happens, we shall not be writing the history.

Meanwhile, there are steps to be taken which aren't outside the powers of reflective people. Education isn't the total solution to this problem: but without education the West can't even begin to cope. All the arrows point the same way. Closing the gap between our cultures is a necessity in the most abstract

7. *Subjective*, in contemporary technological jargon, means 'divided according to subjects'. *Objective* means 'directed towards an object'. *Philosophy* means 'general intellectual approach or attitude' (for example, a scientist's 'philosophy of guided weapons' might lead him to propose certain kinds of 'objective research'). A *progressive* job means one with possibilities of promotion.
8. Almost all college High Tables contain Fellows in both scientific and non-scientific subjects.
9. He took the examination in 1905.
10. It is, however, true to say that the compact nature of the managerial layers of English society—the fact that 'everyone knows everyone else'—means that scientists and non-scientists do in fact know each other as people more easily than in most countries. It is also true that a good many leading politicians and administrators keep up lively intellectual and artistic interests to a much greater extent, so far as I can judge, than is the case in the U.S. These are both among our assets.
11. I tried to compare American, Soviet and English education in "New Minds for the New World", *New Statesman*, 6 September 1956.
12. The best, and almost the only, book on the subject.
13. It developed very fast. An English commission of inquiry into industrial productivity went over to the United States as early as 1865.
14. It is reasonable for intellectuals to prefer to live in the eighteenth-century streets of Stockholm rather than in Vallingby. I should myself. But it is not reasonable for them to obstruct other Vallingbys being built.
15. It is worth remembering that there must have been similar losses—spread over a much longer period—when men changed from the hunting and food gathering life to agriculture. For some, it must have been a genuine spiritual impoverishment.
16. This is not quite exact. In the states where higher education is most completely developed, for example, Wisconsin, about 95 per cent of children attend High School up to eighteen.
17. The U.S. is a complex and plural society, and the standards of colleges vary very much more than those of our universities. Some college standards are very high. Broadly, I think the generalisation is fair.
18. The number of engineers graduating per year in the United States is declining fairly sharply. I have not heard an adequate explanation for this.
19. The latest figures of graduates trained per year (scientists and engineers combined) are roughly U.K. 13,000, U.S.A. 65,000, U.S.S.R. 130,000.
20. One-third of Russian graduate engineers are women. It is one of our major follies that, whatever we say, we don't in reality regard women as suitable for scientific careers. We thus neatly divide our pool of potential talent by two.

21. It might repay investigation to examine precisely what education a hundred alpha plus creative persons in science this century have received. I have a feeling that a surprising proportion have not gone over the strictest orthodox hurdles, such as Part II Physics at Cambridge and the like.
22. The English temptation is to educate such men in sub-university institutions, which carry an inferior class-label. Nothing could be more ill-judged. One often meets American engineers who, in a narrow professional sense, are less rigorously trained than