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THE THREE CULTURES

INDIAN INSTITUTE OF
ADVANCED STUDY
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THE THREE CULTURES

AN INAUGURAL LECTURE

BY

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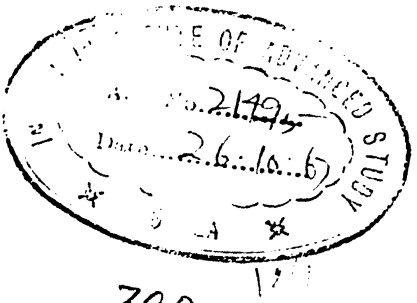

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(Brooke Crutch

'EVIL communications corrupt good manners. Evil communications corrupt good manners. Evil communications....' My memory takes me back well over forty years to a sunny summer's day, to a small hot room in New College Choir School in Oxford with the tantalising sounds of cricket outside, to a picture of my small self and another boy (whose name I have long since forgotten), and to the sounds of steel nibs laboriously scratching out 'evil...communications ...corrupt...good...manners'—fifty times. I can't now recall the reason for this imposition. Was it for 'talking in class'? Had some suggestion of mutual plagiarism been detected in our written work and ungenerously been described as 'cribbing'? It would be a plain lie to pretend that I have never forgotten this or similar early lessons: but it would be nothing less than the truth to assert that as the years have passed I have become increasingly aware of the dangers of evil communications and the overwhelming importance of good communications. For it seems to me that teaching, in its widest sense, and civilised life itself are really matters of good communication; and it is about teaching and civilised life in a university that I want to talk this evening.

You will not need me or expect me to point out that the work of a university teacher does not end with imparting to young men and women the factual bases of the subjects they are studying for academic or professional reasons. We have, of course, an obligation and a vocation to develop their critical faculties and to try to inculcate high standards of intellectual integrity. We want them to be able to keep an open mind—always remembering that a mind is a very difficult thing to keep open, and that those who succeed are always in danger of finding that their minds, although indeed open, are also empty.[1] And if we are not to condone a mere 'nine-to-five university'

we have an even greater responsibility to our students: that of passing on to them the best of our own experience of life. For we want them to leave us not only with an academic degree, but as adult men and women of good character, with sound moral or religious values, with some appreciation of good music, literature, and the arts, able to distinguish between propaganda and truth, between the genuine public expression of the stirrings of social conscience and mere mass hysteria, eager and ready to lead good and useful lives in the service of the world community.

I am sure most of you will be surprised to hear such sentiments expressed by a Professor of Inorganic and Structural Chemistry in his inaugural lecture and may wonder why he has not followed distinguished precedents and devoted it to an exposition of his own subject or field of interest. Some twenty years ago the well-known Cambridge mathematician, G. H. Hardy, wrote 'It is one of the first duties of a professor...to exaggerate a little both the importance of his subject and his own importance in it. A man who is always asking "Is what I do worthwhile?" and "Am I the right person to do it?" will always be ineffectual himself and a discouragement to others. He must shut his eyes a little and think more of his subject and himself than they deserve.'[2]

Now I haven't the least shadow of doubt about the importance of my subject and indeed I genuinely believe present-day inorganic chemistry to constitute the broadest aspect of the whole field of chemistry, to be the most intellectually stimulating, the most aesthetically satisfying, the most valuable educationally, and certainly the most exciting of all the three branches—although I must confess to not having as yet converted my colleagues the Professors of Physical and Organic Chemistry to this point of view! Ought I then to have taken this opportunity to devote my whole talk to inorganic chemis-

try, to tell of my hopes and expectations for its future development in Leeds, or to speak perhaps of my own special interests in research?

I decided not to do this for two reasons. First, there is the problem of communication: for my academic audience today is fairly divided between representatives of the so-called Two Cultures. Secondly, no teacher—however great his devotion to his own subject—should lose sight of its place in the broader pattern of education. The obvious difficulties of communication present only a challenge to my talents as an expositor which I am confident I could meet—although I shall give you no opportunity of judging this for yourselves. Far harder is the task of considering the function and the future of chemistry, and of inorganic chemistry in particular, in the general context of university education.

As I have entitled my address 'The Three Cultures' I had better say something about at least two of them straight away. The phrase 'the two cultures' was, of course, coined by C. P. Snow when he delivered the Rede lecture at Cambridge in 1959.[3] Long before this most of us must have been aware of the breakdown in communication between those whose education had been mainly in the arts or humanities and those whose principal studies had been in science or technology of some kind. C. P. Snow put forward the thesis that the gap between the 'humanities' and the 'sciences' was not a simple consequence of academic specialisation: on the contrary he maintained that the phenomenal growth of science and technology in Europe and America had produced new ways of looking at the world. Scientists and technologists (who he maintained had many traits in common) tended to look at life and life's problems differently and to be interested in different things from those whose education had been on traditional lines. Using the word 'culture' in its anthropological sense rather than with

reference to art and the refinements of living, it appeared to him as though a new culture had arisen in the midst of the old. The seeds of this change were sown during the industrial revolution, but the division between the two cultures has certainly grown faster and become more pronounced during the present scientific revolution which may be said to date from the industrial use of electronics, atomic energy, and automation.

If the nature of our society is changing and our world is becoming dominated by technology, are we choosing the right people to be our leaders? Snow was convinced that this was not the case. He argued that European countries, and Britain in particular, still tended to appoint to senior posts in the government, in Law, in the universities, in the Church, in all phases of public life, and often even in industry, men whose training had been in terms of the traditional culture: this he asserted was likely to prove increasingly detrimental to our interests as a nation, for such people are not really fitted to deal with the problems of a technological world.

Of course not everyone has accepted Snow's general thesis and the topic of 'the two cultures' has stimulated discussion in many circles for the past three years. Indeed in his Richmond Lecture at Cambridge, Dr F. R. Leavis recently attacked the whole thesis with something more than the normal scholarly vigour.[4] He maintained that in so far as there is a new culture associated with the rise of science and technology, it is utterly cheap, shoddy, and indifferent to human values. He went on to embellish this idea by suggesting that the wide popularity of Snow's writing is itself an indication of how shoddy and low our standards have become, for speaking as a literary critic himself he adjudged it as thoroughly second-rate, doing no real justice even to the intellectual virtues of the true scientist, still less to art.

Now I am certainly no blind disciple of 'the Doctor' nor do

I qualify as one of 'the abominable Snowmen'. What merit we or posterity may find in Snow's novels and other writing should not blind us to his perception and to what Wren-Lewis has described as 'a piece of prophetic insight of the first magnitude'.[5] For in focusing our attention on the new scientific and technological culture Sir Charles Snow has indirectly called attention to what might well be described as the most significant change in intellectual outlook in the world in the past two or three hundred years. This change has come about with the acceptance of the concept of experiment, and what is really of far greater significance, the full acceptance of the implications of an experiment.

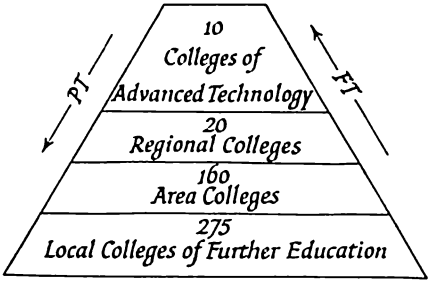
The deliberate use of the experimental method surely implies that one believes experience to form the raw material and indeed the essence of knowledge. If we are prepared to allow the results of an experiment to influence our theories—and in particular to *disprove* our theories—this can only mean that we regard experience as of far more importance than preconceived or traditional ideas. To the extent that our newer scientific and technological culture takes verifiable human experience as its standard of reference it has little in common with the traditional culture which subordinates experience to principles that are supposed to be derived from hidden, deeper realities beyond. It would appear that the newer culture must inevitably challenge traditional authority of any kind, whether of scientific or of religious dogma, of the family or of the Church, and indeed the social structure and law of the land itself. But ought we to go so far as to correlate the increasing domination of the newer culture with increases in juvenile delinquency and with the changing standards—and as some of us still believe, the lowering standards—of sexual morality with which Professor Carstairs dealt so frankly in his third broadcast Reith Lecture[6] when he discussed whether charity or chastity is the supreme moral

virtue. If this were wholly true the gulf between the two cultures would indeed be deep, far deeper than a simple matter of failure to establish communications between the 'sciences' and the 'humanities'. Such a gulf is not to be bridged by mere educational give-and-take, by introducing the arts student to a smattering of science, or by including more liberal studies in the curriculum of the scientist.

People in industrialised countries tend to live longer than those in non-industrialised countries, to eat more food and more varied foods, to work less arduously and for shorter hours, to enjoy more amenities. Many see industrialisation as the one hope for the future of the poorer, backward countries and stress the need for large numbers of trained scientists and technologists to bring about their 'scientific revolutions'. At the same time we are being constantly reminded of the need for more trained scientists and technologists in our own country if we are to improve or even to maintain our present standard of living. It is certainly true that the proportion of young people receiving higher education is smaller in Great Britain than in the United States of America, and that the Soviet Union is producing a higher proportion of technologists than any of the Western powers. All of you will be aware of the various ways we in England are attempting to meet the demands for large increases in our student population whether by the expansion of established universities or by the creation of entirely new ones. You will know something too of the problems of training the increased number of teachers so urgently needed for our schools. You may, however, be less familiar with the remarkable developments in technical education that have taken place, especially in the past decade.

Let us accept the viewpoint that we are now living in a technological age and that Britain is fast moving away from a society based on birth, privilege, and wealth, to one based on

technology, education and qualification. Then if higher education is both a condition and a consequence of a technological society, it ought equally to be a defence against the actual and potential abuses of the modern civilisation it has produced. This puts a premium on the inculcation of human values and on a type of education broadened beyond the inescapable requirements of specialisation.[7] Such an education is now being attempted in the Colleges of Advanced Technology which form the apex, as it were, of the present four-tiered system of technical education.



TGT, technologists; TN, technicians; C, craftsmen; R, research; PG, post-graduate research; P, courses leading to graduateship of professional bodies. A fuller table (from which this was abstracted) is given in note 7.

Fig. 1

The development of the Colleges of Advanced Technology dates only from 1956 although the ten institutions now so designated have a much longer history; some indeed began their work of education—originally only with part-time technical courses—as long ago as 1890. As a partial condition for their designation the entry standards for the Colleges of Advanced Technology were set quite high, either five G.C.E. subjects, of which two at least must be at the Advanced Level, or a good Ordinary National Certificate, or its equivalent. In

November 1961 there were 9264 full-time and sandwich-course students and 15,753 part-time students.[7] A possible total of 27,000 full-time and sandwich-course places was indicated by the Advisory Council on Scientific Policy in its Manpower Report of October 1961. This figure may well rise to 40,000 for the Advanced Colleges in view of the proposed total expansion of higher education to 500,000 envisaged by Sir Charles Morris in a recent Report.[8] As you will observe there is a progressive change in the standards aimed at in the different types of technical training institutions and a progressive change in the emphasis on full-time as opposed to part-time education. With this comes an awareness of the problems of student accommodation and of their social life and activities, and it is commonplace to find that Halls of Residence are being built for existing colleges and that they form an integral part of the conception of new planning programmes.[9]

The academic courses in the Colleges of Advanced Technology have certain essential features. Basic scientific subjects are taught substantially all through the course and technological subjects are treated analytically and not merely descriptively. Introductory professional subjects are so framed as to create awareness in the student of the many non-technological factors on which his future professional success and competence will depend.[7] I shall only mention one such aspect here—worker-employer relations! General studies are introduced to familiarise the student with problems of value in contemporary society, and full-time students spend approximately one-tenth of their class-hours in this kind of work, which is compulsory and examined by written papers whenever this is feasible or is at least controlled by class progress records. In one typical Regional College with which I have the honour to be associated the compulsory subjects spread over a three-year course include English and Communication, English Life and Institutions,

Industrial Organisation and Industrial Law, with optional choice of one-year courses in Economics, the Government of the United Kingdom, Social and Political Theory, Aspects of Modern Writing, and the Philosophy of Science. There is also a two-year course on a foreign language, designed as a general cultural study and not merely to facilitate reading or the translation of scientific and technical literature, though this is a useful consequence.[10]

You may now see why I have entitled my talk 'The Three Cultures', for we may well have here the makings of, not a scientific sub-culture, but a distinctive third culture, a group of people whose education has been neither on the traditional lines of the arts man nor based on that of the university scientist (or, come to that, of the university-trained technologist), people who—unlike their contemporaries in the universities—will have been closely in contact during their professional training with the industries into which the majority will ultimately be assimilated. If trends in the recruitment of students were to follow entirely different patterns, for example from grammar school to university, but from modern secondary school to college of technology, differences between the scientific and the technological cultures could well be exacerbated. Intercommunication on purely technical subjects would hardly be expected to present any serious difficulties or problems: but the same might not apply to contacts on more humanistic planes. Is this possible diversification of interests and ideals a matter entirely to be deplored? Ought it not perhaps to be welcomed and encouraged in an age in which individuality and brilliance are so often suspect, whilst uniformity and conformity are safe passports to success in many walks of life?

The Colleges of Advanced Technology are pledged to secure 'university quality' in conditions of work for their staff and students.[11] This may be taken to mean the progressive attain-

ment of similar standards of staffing, staffing ratios, buildings, equipment, and amenities including halls of residence and students' unions.[7] But those of you who have visited and lectured in some of the new buildings of the 'third culture' will have come away, as I have done, frankly envying them their facilities for teaching and certainly their research laboratories and often lavish equipment. By way of contrast the laboratories of some of the older science departments in the long-established universities are often approaching obsolescence. Over the years current research problems and their relevant techniques are constantly and sometimes dramatically changing. The layout and furnishing of laboratories that may have been admirable when they were first designed thirty or forty years ago may be inflexible and unsuitable for present-day needs.[12] The provision of services will almost certainly be inadequate. Any attempts to modernise antiquated fume-chambers or to introduce newer techniques such as radiochemistry that demand specially designed laboratories must involve major structural work with all its attendant difficulties, inconvenience, and expense. All too often the final result falls far short of what could have been achieved at a fraction of the cost in a new building. University staff and research students in the older buildings are often forced to work under crowded and even unhealthy conditions, in rooms without natural light and ventilation, under conditions that would certainly not be tolerated if the buildings were subject to inspection under the Factory Acts, and which do little to encourage the recruitment of new staff from among the more choosey of today's young graduates. Quite apart from the contrast in working conditions in the most recently built Colleges of Advanced Technology and as if to tip the scales deliberately against the universities—and to pin-point differences between the members of the scientific and technological cultures—salary prospects for junior university lecturers

compare unfavourably with what their qualifications would entitle them to in other employments, more especially in the academically equivalent grade in Colleges of Advanced Technology.

The following figures taken from an article by Dr John Read in *The Times* were prepared by lecturers in the Chemistry Department of St Andrews University. They have received some publicity as providing an explanation of why British science faculties have lost so many of their men in recent years by change of employment or by emigration to Canada or the United States of America. Should you feel that these figures may be biased, or unrepresentative, or based on too small a sample, I would invite your attention to the very recent remuneration statistics published by the Royal Institute of Chemistry.[13] The median figures quoted here refer only to Fellows and Graduate Members of the Institute. You will perhaps know that exemption from the exacting examination requirements for Graduate Membership demands a First or Second Class Honours Degree as a basic requirement, whilst Fellowship is normally only granted to those who in addition have spent a considerable number of years practising the profession of chemistry and exercising a position of responsibility. In a number of occupational categories listed here the standard of qualification represented by membership of the Institute will be higher than that required for a wide range of posts where a degree without First or Second Class Honours may suffice. In such cases it is probable that of the posts held by Institute members a fairly high proportion will be of relatively senior status and will carry salaries above the general level (in relation to age). For example, the earnings quoted here for schoolteachers may be unrepresentatively higher than the real level for graduate school teachers as a whole, or even for graduate science teachers. Furthermore I must emphasise that these

figures do not refer only to basic salaries. For in preparing their returns all members of the Institute in salaried employment were asked to include additional remuneration received in virtue of their employment (for example, any bonus, share in profits, or allowances), together with a sum roughly equivalent to the value of any free quarters provided, and any remuneration derived from professional services consistent with but not forming part of their employment (for example, external examining or advisory work by a university teacher). Few of us here have any illusions about the contributions that these latter can make to some academic stipends. For too many, the length and style of the family summer holiday has to depend on the size of the cheque received for summer examining!

Table 1. *Remuneration statistics prepared by lecturers in the Chemistry Department of St Andrews University*

Occupation	Salary earned during six years after graduation (£)	Salary in the seventh year (£)
Technical College	6120	1720
Scientific Civil Service	6000	1460
Patent Office	6250	1400
Industry	6060	1230
School	5300	1250
University	3750	1050

You will have had long enough to digest these figures to realise the quite inequitable position of the young university lecturer *vis-à-vis* his colleague with no better qualifications in a technical school or college of advanced technology: that the position appears to be reversed in the more senior posts is equally unjustifiable. Admittedly the financial position of the university chemist improves and even begins to rise above the

Table 2. *Remuneration statistics for members of the Royal Institute of Chemistry, 1962*

Median values

Occupation	Total number	Age group 26–30 £	31–35 £	36–40 £	41–45 £	46–50 £	51–55 £	56–60 £
Nationalised industries:								
Transport	32	—	—	—	—	—	—	—
Coal	89	(1320)	(1490)	(1910)	—	(2300)	—	(2500)
Gas	86	—	(1390)	(1750)	—	—	(1910)	(2130)
Electricity	97	1350	1610	1900	(1910)	—	—	(2110)
Atomic Energy	329	1350	1670	2100	2530	2580	—	—
Scientific Civil Service	462	1200	1580	1710	2100	2290	2420	2480
Other government services	191	(1300)	1600	1800	2310	2400	2460	(2540)
Local authorities	175	(1140)	1460	(1670)	(1820)	2000	2030	2120
Hospitals	86	—	(1640)	(1830)	(2200)	(2150)	(2600)	—
Research organisations	288	1100	1500	1830	2120	2060	2150	(2550)
University	561	1090	1550	2000	2340	2550	3300	2910
School	350	1290	1510	1690	1690	1800	1940	1900
Technical College	528	1600	1750	1900	2020	2000	2000	2100
College of Advanced Technology	166	1600	1800	1940	2010	2380	—	—
Other employment	96	—	(1650)	(2150)	—	(2160)	(2760)	(2050)
Self-employed	158	—	—	(3000)	(3950)	(4000)	3500	4150
Industry (private)	5335	1250	1610	2000	2200	2500	2750	2650
All categories	9057	1250	1620	1970	2200	2390	2470	2480

national average for all professionally active categories by the time he has reached the prime of life. . . just when he is getting too old to start a family, and when his enthusiasm, drive, and originality may well have lost much of their initial impetus.

I am sure you will agree that this matter of salary differentials should never have been allowed to occur in the first place, and that it must be rectified as soon as possible or at least when the long-overdue revision of academic salaries is carried out; but not in this case by securing 'university quality' conditions for the lecturers in colleges of technology since this would involve a *reduction* in their salaries! In the meanwhile we should ask ourselves why it is that many well qualified graduates still seek posts in the universities in preference to colleges of technology or industry or other fields of more lucrative employment. I believe they do so because of certain traditional advantages that are, or should be, inseparable from university life. For the scientist there is the knowledge that he will be able to carry out original research work of his own choosing and that he will have freedom to publish his results at his own time and in his own way, that he will be teaching selected students some of whom will certainly be of really first-class quality, that he will enjoy the stimulus and collaboration of colleagues with a similar sense of vocation and adventure, and that he will enjoy personal freedom to an exceptional degree. For every university teacher there is the added inducement, or at least the expectation, of congenial company, the opportunities for intellectual and cultural exchanges, and the certainty that his work is in every sense creative. Dare I add that a post in a university still carries with it certain suggestions of social prestige? But how long will these conditions be the prerogative of the universities? What will happen when the conditions of study and the curricula available in Colleges of Advanced Technology become better known? when the Diploma in

Technology is fully and widely recognised as the equivalent of a high university Honours degree? when post-graduate research in the Colleges of Advanced Technology becomes more common and more generously supported (for it is envisaged that when they are fully developed some twenty per cent of the students will be so engaged)?[14] What will be the position when they are granted full status as Universities of Technology? What indeed will happen when the social climate of this country has changed and there ceases to be any distinction made between the man who has received his higher education in the university and in the college of technology? Will it not then be the case that the scientific and the technological cultures will be in bitter competition for students as well as staff? Shall we in the universities be able to maintain the quality of our intake... and our prestige?

This is not the place or time to raise the question of the relationship between Departments of Technology in universities such as our own and comparable faculties in Colleges of Advanced Technology. Indeed I have deliberately portrayed the products of the latter as a potential new technological culture, a 'third culture' challenging in various ways the purely scientific culture of the universities in order to pose the rather academic question 'Is the survival of a purely scientific culture desirable?' If the answer to this is in the affirmative we must then consider what must be done to ensure its future.

That the Colleges of Advanced Technology have succeeded in providing a technological education appropriate to the needs of contemporary society and in effectively combining professional training with a measure of general studies is largely due, it would appear, to the fact that they were in the enviable position of being able to work from foundations of their own creation and were not handicapped by any pre-existing organisation or curricula. To some extent the newer universities have

the same freedom of manœuvre. Keele has its common first year and Brighton will have its intersecting Schools. But who will say that the Keele experiment has been an unqualified success? Is there any real reason for supposing that Brighton and Lancaster will do better for English youth in the future than Birmingham and Leeds have done in the past? Has the Oxford experiment been a failure?

I specifically mention Oxford because this is a university with which I have a certain familiarity, and because under the system that has operated there for at least the past twenty-five years the average freshman chemist who has passed the Preliminary Examinations in Natural Science before coming into residence need study nothing but chemistry during the whole of his four-year course that terminates with Part II of the Final Honours School of Natural Science—if we except a modest examination in the translation of technical literature from German or Russian into English. The product of such excessive specialisation (and I am not seeking to defend it here) ought to be pathetically narrow in outlook and general culture: but this does not appear to be the case, judging from long personal experience, or the comments of employers, or the success of Oxford chemists in very varied walks of life. Of course we all know that Oxford shares with Cambridge the cream of all potential university applicants. Can this alone be the explanation? Can it be due to the famous tutorial system, that 'mild surveillance by sage and cultivated men' as it was once described? Believe me, the legendary individual tutorial has long been impossible in Oxford save in exceptional cases and it didn't exist among chemists in most colleges even in my undergraduate days. Then how are we to explain the paradox?

It may be that my long incarceration in the Dreaming Spires has blinded me to reality, so that I observe only what I hope to see; that I only see what I know to be there already! Be that

as it may, it is still tempting to reflect on one obvious difference between Oxbridge and Redbrick: that in the former *everyone* is affiliated to a comparatively small yet heterogeneous academic unit—the College or Hall where the undergraduate will find that men reading his own subject are in the minority and where he will be in daily contact with others studying every possible discipline. Here he will spend a year in residence, very exceptionally longer if he is elected to some executive position; but when later (and inevitably) he goes into lodgings he will still keep coming back to this focal point for some of his meals, to meet his friends, to use the college library and its Junior Common Room, and to participate according to his tastes and inclinations in the collegiate life and activities. During his freshman year he will, one hopes, have formed the habit of arguing over the coffee cups, of indulging in those perennial and endless discussions on everything under the sun, from Beethoven to Brecht, from Cubism to Cuba, from the Nature of God to *Waiting for Godot*, from scientific method to sado-masochism, from thalidomide babies to thermonuclear bombs. In short he will have started his self-education, broadening his horizons, learning to talk and present his views to others—perhaps even going so far as to seek out actual facts to support them and confound his adversaries—and certainly he will gain invaluable experience in learning how to defend the indefensible position. Few will seriously suggest that these really vital aspects of university education can be, or should be, organised. But I think we have a duty to make them a possibility for all our students.

It might appear from these remarks that I am biased in favour of Halls of Residence as representing the ideal and the only solution to problems of student accommodation and their extra-curricular education. Nothing is further from my thoughts. But I am very much exercised about the extra-

curricular education of the student who goes straight into lodgings and remains in lodgings for the whole of his academic career, especially if they are some distance from the centre of the university. Here the general problems that arise, and specific cases, will be familiar to most of you and I need not dilate on them now. It will not, however, be out of place to quote the views of a very eminent industrialist when discussing the kind of man fresh from academic circles that the more mature members of his organisation (Imperial Chemical Industries Ltd) would like to have, so that they could with confidence make provision for handing on their industrial responsibilities. In his recent Presidential Address to the Society of Chemical Industry,[15] Lord Fleck of Saltcoats observed that while the flexible, inquiring, and critical type of mind needed in industry can be greatly developed by the academic discipline of a university or college, character training there may be wholly neglected. 'It is quite possible at many Universities', he remarked, 'to contract-out of all college and social life in order to concentrate on pure study. This contracting-out is impossible in residential universities and therein lies a great part of the value of residential experience when... responsibilities of one sort or another cannot be shirked. It is then especially that character can be energised and conspicuously developed by the exercise of leadership in every branch of communal activities.'

Fortunately and wisely this university is not committed to a single form or stereotyped pattern of student accommodation. Some of our students live at home, some in lodgings or flats in the city; we have Halls of Residence and University Flats; we shall soon have study bedrooms and a triple Hall of Residence with both men and women students in the very heart of the university. University policy in this respect has, I am gratified to think, embraced the ideals of the scientific rather than those of the older culture in that it is prepared to experiment—and

to profit from experiments, both those we have made ourselves and those of other universities as far afield as Finland and Italy.[16] But how far can we go and how much further must we go to ensure that every student has the opportunities for assimilating what we believe to be the ethos of a university; what can we do to ensure that each one to leave us goes away as a well-rounded individual with character and personality?

Although I hold with Schiller[17] that a man grows in stature as his interests broaden,

> Im engen Kreis verengert sich der Sinn,
> Es wächst der Mensch mit seinen größern Zwecken,

I do not believe that such character development is incompatible with academic specialisation. I take it as axiomatic that at least some of the effort of a university should be directed towards training specialists: indeed there was a time when it was widely held that the best way of achieving higher education was to pursue the study of a single subject to the very limits of the boundaries of knowledge—and beyond. Although specialisation is nowadays popularly stigmatised as 'knowing more and more about less and less' I hold no brief for courses that teach less and less about more and more, the elements of all the sciences, smatterings of all the arts. Goethe, whom no one could really call a blinkered pedant, supported the view that general culture was all nonsense: what is important is for a person to understand one thing thoroughly. 'In der Beschränkung zeigt sich erst der Meister', he says: 'It is by working within limits that the true master reveals himself.' It is typical of Oscar Wilde that when quoting Goethe's epigram in his essay on 'The Decay of Lying' he should go on to point out that the limitation, the very condition of any art is style. How often do we take the opportunity of calling our student's attention to good and bad style in chemical literature?[18]

If we produce narrow chemists with no time to learn anything but chemistry, this is not because industry requires it or the scientific culture condones it: it is because our methods of teaching are still dominated by traditional concepts and perhaps even by the assumptions of the classical outlook. Learning is still too often regarded as synonymous with the accumulation and mastery of facts and theories, so that with inherently progressive subjects such as chemistry the syllabus becomes overcrowded and we move irresistibly towards narrower and narrower specialisation. By way of illustration here is the last issue of *Current Chemical Papers*, a monthly journal that merely lists the *titles* of papers dealing with chemistry published during the current period. This month's issue contains 2700 titles. There are today in chemistry alone 8000 journals in fifty-two languages originating in 100 countries.[19] It is humanly impossible for any scientist to keep abreast of all new information in his own field or sub-field of specialisation...and still produce original work. The burden of facts and memory-work on the student—especially in some branches of chemistry—has long been intolerable and shows no signs whatever of decreasing. So long as chemistry remains an experimental science and we believe in Robert Boyle's dictum 'He that hath seen it hath more Reason to beleeve it than he that hath not', we shall continue to require students to carry out experiments for themselves. This means that they must shoulder the additional burden imposed by long hours and the physical strain of working in the laboratories, a burden not shared by their contemporaries studying the non-scientific cultures and seldom appreciated by them. We can and we must make sure that laboratory time is not mis-spent in carrying out sterile routine experiments. It is possible to do far more and far better work when the task is intellectually stimulating, and this must be our invariable goal. We must concentrate more on imparting principles than facts.

But a substantial corpus of facts is still essential, and we may and perhaps should without further delay look seriously into the possibility of using machine teaching programmes to this end, even in specialist studies—a prospect that will place still further demands on the time, initiative, and co-operation of staff already generous in diverting time from their personal research and their leisure to conducting tutorials. We shall have to make increasing use of visual aids—a field in which my department has already earned a high reputation throughout the country for its teaching films. Certainly constructive re-thinking of teaching methods and a reassessment of curricula and examination procedures cannot be indefinitely postponed if we are to continue to train specialist chemists to the increasingly high standards demanded by present-day conditions—and yet leave them with sufficient leisure time for the no less important aspects of their extra-curricular education.

I find it hard to believe that I have been your Professor of Inorganic and Structural Chemistry for little more than a year, and that it should have been possible in so short a time to transfer a lifetime's allegiance to Oxford so wholeheartedly to my new university and its problems. If I have gained enormously from the transition, there have been losses too, and I want to tell you what I have missed most. Not friends or former colleagues, for I find that distance has made surprisingly little difference to these relationships; not even the intimate—and let me be frank—the rather luxurious life (by contemporary standards) of my Senior Common Room; not even the collegiate life of St Edmund Hall where I spent so many years; but something one took for granted. I refer to the architecture of the university city. The college buildings and the delicate balance between quadrangles and gardens; the glorious unplanned sweep of the High; Magdalen Tower outlined against the last rays of a summer sun; the innumerable and unexpected

gems of what I believe Dr Thomas Sharp described as 'Townscape' in his sadly neglected book *Oxford Replanned*.[20] There was, too, that extraordinary feeling of historical continuity, of the great tide of scholarship flowing unchecked through the years—in my own Society academic life had continued without a break on the same site for over 700 years! How much do surroundings subconsciously and imperceptibly mould the character and outlook of Oxford's students?... or the character and outlook of our own? As an example of good, or at least of fortunate, planning I would ask you to look at this view* of the first building of a new Regional College of Technology—the Lanchester College at Coventry—although this slide does scant justice to its charm and architectural quality. Now look on the view from the opposite direction† and observe the spectacle that confronts every student as he passes daily through the gates—the glories of Coventry Cathedral and Epstein's magnificent bronze statue of St Michael and the Devil. So you will appreciate why in this very unorthodox inaugural address I can say how much I look forward to the time when the Chamberlin Plan has come to fruition and the nearby dreary streets will have been transformed into a unity of academic buildings as aesthetically stimulating as they are architecturally and functionally satisfying. I hope too that our campus will be enriched with gardens, pools and fountains, and especially with worthwhile sculpture, and our rooms by every form of art. Now that the welfare state has taken care of so much that was formerly the province of private and enlightened endowment, here perhaps is an almost virgin field for potential benefactors!

My time draws to a close. I have talked in very general terms and said all too little about inorganic chemistry. I have cer-

* A Kodachrome slide was projected here showing the first building of the Lanchester College viewed from the road looking along the tree-lined approach avenue.

† A Kodachrome slide was projected here.

'Y'know what I miss, though?—that good old pouring stuff from one test tube into another.'

Reproduced by permission of *Punch*

Fig. 2

tainly started more hares than I have had time to course. The 'wind of change' is blowing so briskly through all universities that the most daring proposals and innovations can seem tamely conservative in a brief space of time, and even in the interval between writing and delivering this address one senses that

> . . . last year's words belong to last year's language
> And next year's words await another voice. (T. S. Eliot)

Since this lecture was advertised as being 'illustrated' I fear that many of you may have been brought here under false pretences in the expectation of seeing spectacular and novel experiments performed. But you will remember my pointing out earlier on that the older culture placed tradition and authority before experiment: and clearly there are no provisions here for an experimental lecture requiring gas, electricity, water supplies and drainage. You might even suppose that this magnificent arts theatre was specially designed to exemplify the gulf between the traditional and the scientific and technological cultures or at least to demonstrate the dominance of the older culture by preventing an appeal to base experiment. You would not be entirely correct, for the necessary services for an experimental lecture do exist—under the floor; and given due warning and the assistance of a husky team of technicians an experimental lecture bench can be assembled. Perhaps this concession may be taken as symbolic of the willingness to bridge the gulf between the cultures and the practical difficulties of doing so.

There are, even among scientists, some iconoclasts who feel that the training of the chemist need nowadays no longer rest so heavily on experimentation. May I crave your indulgence on this serious academic occasion by putting my opinion on this matter in the form of that famous Punch cartoon with the nostalgic caption 'Y'know what I miss, though?—that good old pouring stuff from one test tube into another.'

NOTES

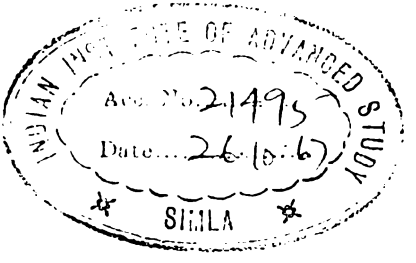
1. Martin Cooper, *Daily Telegraph*, 25 September 1960.
2. G. H. Hardy, *A Mathematician's Apology* (Cambridge University Press, 1940), page 6.
3. C. P. Snow, *The Two Cultures and the Scientific Revolution*, The Rede Lecture (Cambridge University Press, 1959).

4. F. R. Leavis, Richmond Lecture, Cambridge: *Two Cultures? The Significance of C. P. Snow* (Chatto and Windus, 1962).
5. J. Wren-Lewis, *I.C.I. Magazine*, no. 307, vol. 40, Aug.-Sept. 1962. I have drawn freely from this article, which appeared when I was preparing my lecture. It expresses some of my arguments more clearly and at greater length than would have been possible in the time I had available and it develops *inter alia* the theme of the interrelationship between the scientist, the artist, and the religious man.
6. Professor G. M. Carstairs (Edinburgh University) in the third of the Reith Lectures, B.B.C. Home Service, Sunday, 25 November 1962.
7. P. F. R. Venables, 'The Colleges of Advanced Technology', *Science and Industry*, 8 September 1962, page 1596. I am indebted to Principal Venables for permission to quote from his article.
8. Sir Charles Morris in *The Expanding University*: a report edited by W. R. Niblett (Faber and Faber, 1962).
9. Cf. 'Battersea College of Technology', by D. M. A. Leggett, *Chemistry and Industry*, 6 October 1962, page 1730.
10. I am indebted to Dr A. J. Richmond, Principal of the Lanchester College of Technology, for a great deal of valuable information about courses and planning programmes in his college and also for the two colour slides shown later in the lecture.
11. Statement of evidence to the Robbins Committee, cf. *Chemistry and Industry*, 1962, page 576.
12. Several days after this inaugural lecture had been given I received a copy of Professor N. N. Greenwood's inaugural lecture, 'Patterns of the Invisible: the Shape of Atoms and Molecules', delivered at King's College, Newcastle upon Tyne (published by the University of Durham, 1962). On page 16 we read, 'It is clear that any planning of scientific laboratories, such as our own Chemistry Building, which was done in the immediate post-war period on the basis of conditions in the nineteen-thirties is now totally inadequate...if we do not take drastic action immediately we will be condemned to becoming

a second-rate Institution within five years. This, of course, is quite independent of the calibre of staff: but it is also certain that scientists will tend to leave such departments and gravitate towards those that have been planned with the needs of the second half of the 20th century in mind.'

Cambridge and Oxford and many of the older provincial universities already have new laboratories. The Chamberlin plan does not make any provision for new chemical laboratories in Leeds.

13. Reprinted by permission of the Editor from the *Journal of the Royal Institute of Chemistry*, 1962, volume 86, pages 303–11.
14. Cf. Gerald Walters in 'The Colleges of Advanced Technology and the University Tradition', *The Universities Review*, 1962, vol. 34, page 70.
15. *Chemistry and Industry*, 21 July 1962, pages 1300–3.
16. Confidential Report to the House and Estates Committee by the delegation sent to study housing in certain continental universities. The University of Leeds, July 1962.
17. Prologue to *Wallenstein*, lines 59–60.
18. I am not referring here, of course, merely to defects of prose composition and the common grammatical errors so brilliantly pilloried by Dr R. S. Cahn in *The Presentation of Papers for the Journal of the Chemical Society*. Cf. also 'Standards of English in Science and Technology', by A. J. Kirkman, *Nature*, 1962, vol. 196, page 807.
19. Professor I. M. Kolthoff, Convocation Address, University of Minnesota, 1961. A later estimate (ref. 13, page 14) refers to '120,000 papers a year published in 9800 journals'.
20. Dr Thomas Sharp, *Oxford Replanned* (The Architectural Press, London, 1948).



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