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ARE THERE REALLY MEN OF BOTH "CULTURES"?*

> "We have too many specialized worlds that have no connection with each other."
>
> Pierre Boulez, *Time Magazine*, 27 September 1971

The 1959 Rede Lecture is now almost as famous as its author, Lord Snow; and its portrait of intellectual elites as well as natural luddites circulated among the reading masses as bread and butter. "Two cultures" is so hackneyed a phrase that it has been admitted to several dictionaries, elevated to the altar of historical truth, and now made the subject of formal university courses from Harvard to Berkeley, MIT to La Jolla.

That there were, and still are, difficulties with Lord Snow's formulation is not news. Months of paper warfare in the dailies, weeklies, and quarterlies, in addition to the internecine *ripestes* of Dr. Lewis, are only a dimension of the fracas. When critics in the Sixties dissected and vivisected Snow's two cultures, they prescribed further exploratory surgery. After a seeming cure, complications that reopened the wound were discovered. New warfare ensued and ended in bitter logomachy.

What is a "culture"? Precisely *which* two cultures, and what about the counter-culture? What certainty that there is not or will not be a third, fourth, or fifth culture? What about the immense problems of communication within a single culture? What is the history of the organism? Why did the rift arise in the first place? Is it a genuinely cultural divide or something else?

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Lord Snow responded but not to the satisfaction of his opponents. He had resisted explanation from the start:

> I have thought a long time about going in for further refinement: 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 subtilizing any more would bring more disadvantages than it's worth.[1]

Possibly true. But the subtilization would still be made—if not by Snow, then by the opposition, by outsiders with no vested interest or ax to grind, and—not emphatically—by the counter-culture.[2]

Where are we two decades later? The present paper is a partial answer originating in two places. First, a comment in Snow's Rede Lecture that the "non-scientists have no conception of the scientific edifice at all;"[3] and second, a remark by a German philosopher personally uttered to me last year while on a tour of the German universities: that the non-scientists have *never* had any conception of it and never would.

Snow's comment was actually the truer. He was talking exclusively about education: syllabi and the like. He had stated that even if the non-scientists *wanted* to possess knowledge of the scientific edifice, they could not. "It is rather as though", he wrote, "over an immense range of intellectual experience, a whole group was tone-deaf."[4] This idea of tone-deafness stuck in my ear. The German philosopher had more specifically maintained that in the whole of recorded history only a few men were profoundly knowledgeable of *both* the science and arts of their time. I asked him to name them. He replied Aristotle, Bacon, Goethe, and Hegel. A strange lot of bedfellows, but such was his contention.

Neither Snow's remark nor the German's strikes me as true. Somewhere, I thought, physicists and engineers must read Shakespeare and Dickens with delight, and, conversely, some of my literary colleagues can describe the Second Law of Thermodynamics. Contrarily, if today Aristotle's genius is universally recognized and his scientific learning considerable, his literary acumen, notwithstanding *The Poetics*, is controversial.[5] And if Goethe fits the bill to a remarkable degree, the same cannot be said for Bacon, who apparently neither carried out the experimental program he advocated nor seems to have understood the most comprehensible of his literary contemporaries, let alone the esoteric writers whom one would expect to be understood by an inhabitant of both Snow's cultural realms.[6]

The matter is, of course, more complicated: the two cultures are not so black and white as has sometimes been thought: between them is a vast gray plain on which the two overlap, the almost untrodden hinterlands of biohistory. We are, furthermore, just beginning to learn—thanks to the school of French structuralism, Chomsky's Cartesian linguistics, and the even more recent teachings of anti-Chomsky-ites—how litt'e is known about the nature and function of language; and it is strong delusion to think we have understood the "other culture" without comprehending fundamental linguistic precepts. And then there is the problem of obsoletism; one no sooner latches on to something that seems terribly significant as a mode of unlocking the problem and discovering access to its heartland, than his theory is pronounced out of date. That I should presume in approximately twenty pages to answer either Lord Snow or my German philosopher is itself an act of outrage. But I ask your indulgence in attempting to sketch out something historically a little more accurate than either, while emphasizing that it indeed falls short of a proper survey or guide.[7]

I. *THE QUESTION*

I suppose that the question itself, as given, is incredibly muddy, and may not even make much sense. If, for no other reason than that science and the arts were, strictly speaking, not considered independent activities before the eighteenth century—and then there is plenty of evidence of their cohabitation even after that. But recently, perhaps in the last two or three centuries, hostility has developed, even if our educational system on the surface seems not to reflect this. Scientists and non-scientists alike, all imbibe Shakespeare in school and all possess some notion, however primitive, of cell structure. We exchange art books for Christmas and visit planetariums on holiday. But if we stipulate *meaning* as a necessary condition; if we ask what does this play by Shakespeare *mean*, or what do you mean by the concept of a cell or atom? —then the matter takes on a very different color. Then we are describing a strikingly small elite comprised of highly educated people among whom there cannot be more than a few who embrace knowledge of both spheres. The problem is, how much ought we to refine and "subtilize"—Lord Snow's term —the gray area between "have you read a work by Shakespeare?" and "what does this work *mean*?" To be sure it is naive to think that most people who can describe the Second Law of Thermodynamics actually possess any *understanding* of its origin, genesis, implications, and relation to other scientific laws. As preposterous as assuming that the engineer who laughs at Falstaff and

weeps over Hamlet discerns, clinically and analytically, why these characters have moved him.[8]

Muddled though the question is, I still should like to brave it. Which men in history were genuinely versed in *both* science and the arts? If my *catalogue raisonné* is sorely deficient, you will understand that I am skimming through two thousand years, selecting what suits my purposes, implicitly abjuring the rest as foreign, and leaving for the printed version of this talk some of the best examples I have found.

II. *STANDARDS, IDEALS, AND ATTEMPTS AT DEFINITION*

Lord Snow continues to maintain that "the two cultures were already dangerously separate sixty years ago",[9] at the turn of this century. It is less evident that they were *dangerously* growing apart before that; not, perhaps, in the obvious sense, but still growing apart. True, Aristotle, Pliny, even Lucretius, took all knowledge as their province, while Michelangelo influenced Renaissance anatomy, Da Vinci early technology, and Milton, prince of poets, peered through Galileo's telescope.[10] But gazing at stars, as Milton so wondrously did, hardly qualifies him for a degree in astronomy or *entrée* to a scientific élite, especially if we make a translation to the equivalent correlative today.

At precisely this point, the question begins to fail us. We have no controls for proving or disproving anything, and it isn't even clear if proof is what we want. By "genuinely versed in both science and the arts" do we mean that a painter, for example, reads anatomical treatises, or that a poet uses scientific expressions and gets them right, or do we mean something else altogether? If the former, surely that will not do, for then science never could be any good to art: mere influence is not enough under any circumstances. Even in the 1959 Rede Lecture, Lord Snow insisted—and rightly so—that "science has got to be assimilated with, and as part and parcel of, the whole of our mental experience, and used as naturally as the rest".[11] Today we know that science can never become a region of our minds: the hostility to it from every corner, even its closest allies, is too great. But one still wishes to interpret Snow's original meaning and answer his questions before sketching out the decade between: 1959-1969.

I have been told that my standards here are impossibly ideal; that we today live in an age in which one cannot keep abreast of his own small field, let alone of another man's. But past heroes do exist. Goethe serves as a good

example: the greatest of German poets, he was also one of the first serious students of environmental influence on plants, an aspect that occupies a central position among topics for modern biological research. Yet he did even more: having failed in an attempt extending over many years to discover the archetypal plant, the *Urfplanze*, he endeavoured to study biological morphology, that subject which, unlike anatomy, seeks to elucidate the processes governing achieved structure rather than descriptions of the structure itself.[12] Like Coleridge and Bonnerot, or Albrecht von Haller before him, he was both a poet and creative scientist; but Goethe, unlike Erasmus Darwin whose *Botannic Garden* represents a nadir in English poetry, was able to assimilate his scientific experience into perdurable poetry. The great English neuro-physiologist, Sir Charles Sherrington, on the other hand, creatively innovated in science, delivered in 1942 a beautifully polished Denecke lecture at Cambridge on Goethe's view of nature (although some Germanic scholars have taken him to task for several of his assumptions and generalizations), but could not himself write verse of enduring merit.[13]

This matter involves more than a degree of genius present in a man, and leads me to the next point: the role of imagination in attempting to know and actively learn about *both* areas. Perhaps no one since the Second War has written more eloquently on the subject than Sir Peter Medawar, the Nobel Laureate in Medicine for 1960 and the Director of the National Institute for Medical Research. I refer to his now famous essay, "Hypothesis and Imagination" in *The Art of the Soluble* (1967), but he has also discussed the topic in *The Future of Man* (1960) and *Induction and Intuition in Scientific Thought* (1969). Despite occasional insights, Sir Peter's *literary* attainments are not outstanding; certainly they say nothing the professional literary men do not know. If Lord Salisbury's (1830-1903) laboratory at Hatfield was amateurish, the same label must be given to Sir Peter's humanistic ones. His Romanes Lecture on "Literature and Science" (1968), published in *Encounter* (January 1969), was attacked by literary critics as rough and inflexible, and precipitated a heated debate revealing that Medawar doubtlessly knew more about science than about the arts. The problem is not, as one polemicist noted, that Medawar's literary precepts simply would not galvanize anyone, but that he had not really read English letters in all their breadth and enormous variety. Medawar's difficulty, therefore—and if one may resort to such strong language—stands at oblique angles to the stereotype of an idiotic literary scholar who throws up his hands—as I have actually witnessed on the campus of a great American university—and says he doesn't want to know a thing about science

because the field is too big.[14] Medawar has tried; he has read; he has digested a fair amount of quintessential and even esoteric material. But what he has consumed, essentially the Romantic poets, has been filtered through a curiously rigid crucible that unflinchingly fuses literature with his own predilections for scientific truth; one that causes him, for example, to talk about Blake and Shelley as if their poetry were of the same order as *The Optics* or *The Origin of Species*; as if Blake's "Nobodaddy" or Shelley's "Arch Fiend" were simply a mindless pair—maniac and tyrant—who had stupidly missed the whole point of early nineteenth-century materialism and applied science. Nowhere does Medawar give us a clue that in literature, especially poetry, words are often trying to say something *other* than what they actually do say. "I do"—those two simple monosyllables—placed at a certain moment in a play by Shakespeare or a novel by Joyce can give us the whole world; elsewhere, in a treatise by Darwin or Mill, they may denote the most insignificant trivia.

Most past scientists have not fared much better, although there seems to be less to know as one recedes from the present. The few scientists who have actually read the "other culture" have not left impressive remains. Dr. William Whewell, the noted nineteenth-century philosopher and Master of Trinity College, Cambridge, wrote journals that teem with literary references and obscure allusions demonstrating familiarity with English poetry through Keats.[15] But little evidence exists of his making the slightest sense of what he read, at least if the best critical writings of his contemporaries are a means of measurement. His case illuminates, once again, the chasm in the early Victorian era: even then the "two cultures" were dangerously separate, if by "dangerous" one connotes a degree of understanding. The Huxleys were more "literary" and their ideas more flexible, but one searches in vain for distinguished work in both realms by a single member of the family. William Carlos Williams, a mediocre twentieth-century physician who wrote first-rate poetry that will be read centuries in the future, such as *Patterson*, has exploited a certain amount of his medical knowledge in his poems; but the converse is nowhere apparent: of poetry having made the slightest difference to his practice in New Jersey.

III. *ASSIMILATION OR NOTHING*

One point about the interrelationship of science and the arts, then, entails assimilation of each, as Snow says, by the other if either ought to be labelled profoundly, or even significantly, influential. This sounds good in theory; what does it mean in practice? Newton's non-mathematical works

are abundant testimony of the failure of significant influence: his histories and chronologies of ancient kingdoms reveal no great prose style and display little indebtedness to seventeenth-century masters of the English language.[16] The reception of these writings involves a certain amount of recognition by later scholars, but comparison with Milton proves discouraging: if Milton, to turn back a century, romantically dreamed about worlds without end while looking through Galileo's telescope and was able to infuse his epic poem with the spirit of the New Astronomy—therefore his perpetual muse Urania—Newton, conversely, achieved nothing of the sort and appears pale in contrast. Movement backwards and forwards, carrying over from one realm to another, rarely appears in actual practice, even among towering intellects. Unless we mean something negative by assimilation, very little of it is to be discovered by combing the annals of the past.

Lord Snow notwithstanding, history teaches that the humanists have in this regard fared better than the scientists. Science has not, to echo Keats, unwoven the humanist's rainbow; nor has she, as Wordsworth sporadically feared, dismantled the poet. Quite the contrary, the humanists have been the *avant garde*, as it were—the more aggressive and voracious for foreign knowledge. If not "mandarins" themselves, commanding vast empires of knowledge, they have at least carried the torch to break down formidable barriers. Hegel's philosophy of nature, for example, and to a lesser extent his philosophy of history and art, as well as his general dialectics, are grounded in sound scientific method about which he probably would not have known without formal training in science. He spent many years studying mathematics and astronomy, wrote a scientific habilitation thesis, *De Orbitis Planetarum*, in which he violently attacked Newton and demonstrated *a priori* that there could not be another planet between Jupiter and Mars, and constructed a system of history, whatever its faults, which firmly straddles the shadowy boundaries of science and humanism.[17]

Hegel typifies "assimilation" at its best and most imaginative. But examples are rife of the opposite tendency—alienation—and they are weighty in number and distribution throughout time. If Bacon seems to have appreciated little in the poet's or painter's repertory, Julian Sorrell Huxley has not in our own century come out much better. Who, today, revives his films or reads *The Captive Shrew and Other Poems of a Biologist*? If these poems, or what passes as poetry, had a certain limited vogue during the Thirties, this was not because the critics were duped but was owing to the honesty and unpretentiousness of the poems themselves—to Huxley's having said the kind of

things about evolution and ethics people then wished to hear. Huxley demonstrates assimilation on the surface only; underneath exists a deep current of alienation, although one would never know it from reading his many treatises on scientific humanism in which the "two cultures" are seemingly wedded.[18] They may theoretically appear to have sustained each other in Huxley's mind, to be necessary to his innate sense of progress, and to all his theories of the origin and basis of religion. But all his syntheses and proselytizing were an attempt to convince himself that he wasn't alienated, wasn't immured behind an iron gate with no exit to the free world; and the fact now having come to light—as his appraisers agree—entails plenty of alienation within his professed credo of progress, science, and more scientific-progress. Having woven a mazy rhetorical web, he convinced his contemporaries that, despite the horrors of materialism, they could make it to the next day.

By now the scientist's alienation lamentably seems permanently fixed. Ludwig von Bertalanffy, the Canadian scientist who has done much research into theoretical organismic conceptions in biology, has recently proclaimed to the North American press that he is interested *only* in science; and the late J. D. Bernal is known to have asked T. S. Eliot at a banquet honoring illustrious men, precisely what aspect of *The Wasteland* caused so many people of such different backgrounds to wish to read it: Eliot stared and finally replied, the poetry itself, not its ideas, which left Bernal baffled and speechless. Linnaeus, the great Swedish taxonomer of the eighteenth century—may have cultivated the company of dogs but not, so far as I have been able to learn, the fine arts or *belles-lettres*.[19] In the writing of modern scientists, alienation is not infrequently transformed and its target located in university curricula, as in the acidulous remarks of Cyril Darlington, the British geneticist who has been angrily excoriating the humanities for three decades:

> In general, the dead hand of ancient endowments has tied down our universities, and through them our schools, on the sterile bed of verbal erudition. It is a bed on which they have made themselves very comfortable. Our educational system has become devoted more and more to repeating the past and less to creating the future.[20]

Naturally, the task of appraising professional scientists who dabble in the arts involves a smaller chore than artists who rarely wander into scientific beds. Conrad Waddington, the animal geneticist who instructs in the eminent university of this city, throughout his distinguished career has painted canvases and has written a book studying certain aspects of the influence physics and

chemistry in particular have had on painters: *Behind Appearances: A Study of the Relations Between Painting and the Natural Sciences in this Century* (Edinburgh, 1969), which opens with this magnanimous pronouncement: "Any person who tries to remain alive in all his faculties must be ready for the experiences offered by several, if not all, of the main types of human experience, even if his own work is only one of them." But ultimately the book does not demonstrate the best creative possibilities of "both" worlds, as reviewers apologetically noticed. Waddington's other partly humanistic book, *The Nature of Life*, reveals a very different view of *both* nature *and* life from that of many humanists, especially its confidence in progress and its refusal to gaze at inevitable processes of decay inexorably indigenous to the human life cycle.

Nowhere, however, do we view the gap between Snow's two cultures more appallingly than in the roster of Nobel Prize winners, from its inception in 1901 to the present. A sea, indeed a vast ocean, exists between the physical-chemical names on the left hand of the page, and the literary on the right side. From Yeats and Mann to Camus and Borges, I find no name in which science has been incorporated and "assimilated" into the tissue of the author's art. Bertrand Russell stands alone; but even he has not risen to the level of a Goethe. If Shaw, to look upon another contemporary, seems incessantly to babble about science—in specific characters like Tanner in *Man and Superman*, throughout his play *The Doctor's Dilemma*, and in all his commentaries[21]—the impression carries a good deal of deception: his doctrine of creative evolution stands almost in premeditated opposition to everything Darwin wrote and said, and challenges, in addition, the deepest bases of the rest of nineteenth-century science. Shaw was a social propagandist who would not have bothered with the scholia of Newton's *Opticks*, for example, let alone with the *Opticks* themselves. For him as thoroughly and conclusively as for Joyce, science was an unprepossessing wraith: portentous and beckoning but ultimately too ridiculous and patently absurd to bother with.

My contention, then, is that modern science doesn't really seem profoundly capable of favorably nourishing art, and vice versa—at least not recently. A good case can be made—and it has—that it nourishes criticism, but that is another matter altogether and does not detract from my assertion.[22] Literature, as here discussed, embraces *primary, creative, imaginative* works: poetry, drama, novels, stories, fiction. Medawar has commented more strenuously than I on a subset of this idea. "Science", he has written, "tends to expel literature, and literature science, from any territory to which they both lay claim".[23] The law applies as well to art-at-large, not merely to literature, in a highly technological

society like ours. Nowhere in my opinion has this been more apparent in recent years than in purgatorial areas touching on human behaviour and personal conduct. Flower children and soldiers alike, intuiting that they could contribute nothing to either sphere and caught in the loins by an unbanishable technology, have turned to a pipedream world of hard drugs, unisex, and the New Jesus, knowing fully well that their alienation could never become reconciled to a world they hate. If these developments are recent and seemingly transient to optimists, their aetiology transcends fashion. Owing to the specialized education we promote, the revolt of such groups will probably remain, only its momentary style changing. The precise reasons for this horrible development—and every day it grows worse—have eluded men everywhere. But of one strain of its truth we may be sure: that those men who profess to ameliorate the condition by looking deep into the past, by legislating now from its annals, are doomed from the start. The combination of such profound learning and naive belief in history I ungrammatically call "gullibility to the past", glancing backwards at Swift's deluded madman.

IV. *THE GULLIBILITY SYNDROME*

To return to the seventeenth century and William Harvey is practically to speak of our typical and paradigmatic ignorance about the relation of science and the arts. So scholarly and fine a collection of essays as Hedley Howell Rhys' *Seventeenth Century Science and the Arts* (1961), containing essays by Stephen Toulmin, Douglas Bush, Claude Palisca, and James Ackerman, educated everyone concerned when it appeared, but on further reconsideration, and viewed in the perspective of time, it left unanswered the largest questions it attempted to answer: questions relating to definition and precise statement of what constitutes *science* and what *art*. Take Harvey as an example. He is known during his middle age to have purchased paintings for King Charles and in old age to have read by day and by night the Ancient Classics.[24] All details and a context are gone; and yet context here is everything. Did Harvey actually possess expert knowledge of painting? Did Virgil's poetry nourish his science or was his reading a pious act of obeisance? Did he read epic poems imaginatively or did he read Virgil and Ovid as elderly people read the Bible? Was Harvey's attraction to the Classics based on some attribute uniquely inherent in its authors, or did he read because the innate act itself diverted him from daily anatomical explorations? Dozens of other possibilities exist to answer these and other similar questions—to explain his activity. This leads me to my last two points: first, what I have elsewhere called and continue to call the "Gullibility Syndrome", and, secondly, to the urgent consequences we face of

specialization—consequences that must influence virtually every aspect of the problem set by this symposium, the intimate interrelations of science and the arts.

The important matter for us today and tomorrow—to continue with the example—establishes priorities among questions related to the subject. It creates a context by which to evaluate the question concerning the Harveys of this world, who may or may not have studied the ancient masters, who may or may not have been able to tell the difference between a Correggio and Raphael, or recite Virgil with early morning ale. Only by so doing can it lead us to clues about the kinds of assimilation for which we are apparently looking (although it hasn't as yet been made clear by Lord Snow or anyone else just why this assimilation is culturally good). Harvey, in fact, seems nowhere to have assimilated art into the fabric of his science. Why should he have? He was a practicing physician. How could he have in his written works? A considerably annotated passage in *On Generation*[25] comparing the observations of scientists and painters perhaps will serve to enlighten us of the difficulties. Different painters, Harvey affirms, paint the same scene in many ways; no two paint it similarly. Because observation is so untrustworthy, he continues, the scientist must observe the same phenomenon over and over in order not to end up with a series of dissimilar "paintings".[26] Even here the two realms irreversibly "expel" each other: painter and scientist competing for the same field, the same ocean, the same object. Gullible students, as gullible as Gulliver travelling in make-believe land, merely on the basis of a few brief extant statements about Harvey's collecting for King Charles, have made a seemingly air-tight case for his "abundant humanism", demonstrating, once again, the human proclivity for generating fallacies.

Such gullibility not only reminds me that most history, as we know it today and as we have known it in the writings of others, is fallacy or, still worse, fantasy; but also of specific cases, as for example, a story about an Oxford Classics Professor who had never left England until he was invited to lecture in California. Having learned to drive while there, he insisted on following in a second car his host who bribed every petrol station attendant along the route to inquire matter-of-factly of the don, "are you not the Professor at Oxford?" The bewildered don, back in England after a fortnight, still in a state of shock and soon afterwards no longer able to contain his amazement, proclaimed hysterically to the Senior Common Room of his college: "It is not true! The Americans are not barbarians! Every petrol station attendant in

California *knew* I was the Professor of Greek at Oxford". Far more incredible than the outrageous tale itself is the fact that his Common Room could believe the ridiculous episode ever to have occurred.

Gullibility, though, knows no boundaries, especially in modern times and in the writings of some modern thinkers who have been inclined to fabricate a much larger edifice and postulate the existence of a much greater "cultural interaction" in the past than solid historical facts support.[27] In the last two centuries, the threat to both science and the arts of each "sub-culture" (and there are many more than two) has been accelerating at an alarming rate; before that, whatever interaction existed was not conscious or premeditated. Unconscious influence, as Snow himself and his followers will concede, operates in a totally different manner from calculated influence, and though it seems to the modern that the twain meet in a kind of "twilight zone", the mere delineation of it begins to lend clarity to the history of the interaction. Today the influence is altogether different: the scientist who embarks on research or sets out to write on "genetic engineering" knows fully well beforehand that he must—consciously—fuse the discoveries of biology, engineering, ethics, and —if he is conscientious—English style. In so doing any number of unconscious assumptions and presuppositions admittedly are operative and creep into the text of his writing; but such subtle insinuation cannot be compared with the unconscious procedure of the seventeenth-century scientist, for example, who, like Harvey, never separated the various branches of humanistic and scientific learning to begin with.[28] We are therefore dealing with *different kinds of problems*, of differing parities and magnitudes, of entirely different orders of complexity, and we do not abet the answers or enhance the likelihood of approaching historical truth by lumping them all together as if they were synonymous. Gullibility ultimately involves a non-discrimination of questions and answers on the most rudimentary level; the non-ability to isolate a specific question, or strain of a question, and suggest a range of likely and probable answers. It also involves correctly solving, for example, the problem of relating Harvey's many varied activities within a context that gives meaning to each individually. In our own time, Snow and Medawar have been far more "correct" than many others, although one would never know it from the slick and glib manner of their presentation: crude, unqualified, unrefined, unscholarly. These men have at least been willing to point out loopholes, to discriminate blindness and insight: travelling for Charles, composing an occasional analogy in a scientific treatise—these most emphatically do not constitute "assimilation" of the two cultures by each other.[29] Which leads me to the

second and final point: the two cultures in this century and the future of specialization.

V. *SPECIALIZATION AND ITS DISCONTENTS*

We all know how much of our educational malaise today is a revolt against specialization.[30] In no other age in recorded history have young people been required to know so much about individual disciplines. And yet, the lure of other subjects, especially for the young, appears to them inescapable, most apparently in our universities. Who, the elder statesmen among us ask, can encompass *both* cultures? Where dwells a Prometheus who can lift both science and the arts on his shoulders? But the young, as blind as Roman andabata in combat, not realizing they are the grotesque children of Frankenstein, dreamily imagine it can be done. They are idealistic and unknowing. They are in for a jarring shock.

Here, again, we perhaps ought to rehearse the stark reality for a symposium such as this: that it is not enough for the participants to immure themselves in secure and remote ivory towers, to escape into a mythical past, to deal only as antiquarians and historians with the immense problem of the history of the interrelations of science and the arts, to construe the matter merely in a dehumidified void containing no tunnel to the present and, achingly, without the remotest possibility of influencing the future. For the historian's role itself has now been uprooted, his prestige lost, and any residual sense of his conception of himself as a Faustian creature, wallowing in the pleasure of possessing all knowledge, debunked. Our age of uncertainty regarding everything from mathematical laws to moral principles renders him at best an obsolete character type. Knowing every aspect of the interrelation of science and the arts in the past will not solve our problem *today*: despite the amazing advances of technology, each day seems harder to get through than the previous. Those of us who are dons suffer the same condition no less than other citizens in the same society. Three decades ago Cyril Darlington, perhaps unwittingly but still prophetically, sketched a blueprint of what then seemed to be a distant future. How true it rings today: "The universities have the means to adopt living knowledge. They also have the means to resist it. But established, as they were, to promote dead knowledge, knowledge of no danger to society, they naturally choose to resist the living and cleave to the dead, which is always unmistakable and unalterably pure".[31] If only our problem in 1972 were a monolithic cleavage between two seemingly irreconcilable types of university education! Or even the slender matter of promoting an amicable ambience in which

scientists and humanists can speak to each other. Instead, we in 1972 are faced with a deadly sort of gradual decay—not a revolution but a kind of unprecedented global disintegration—of our most cherished structures (education, the law, safety, manners, morals, art). Such imminent decay goes far beyond any local problem restricted to the universities. An aspect of this decadence involves the existence of disparate worlds which, as Boulez intimates, are not talking to each other, and in some cases do not even know of the existence of one another. And we won't encourage them by resorting to a past that has no meaning for *them*: Vitruvius, Bacon, Milton, Newton, Leibniz, the Darwins, Whewell, Hegel, Goethe. In a sense the order of the problem so far exceeds an academic dimension that folly alone could impel us here today to believe we can influence a solution, assuming solutions exist. But insofar as we can make any infringement, I am absolutely certain that the "history of the development"—to lend it a ring of respectability— will alone not put together the pieces. In chronicling and evaluating the past, it cannot have been enough —even in the far distant past—to *know* about both, remote as that possibility is for epochs when the two realms were never separated in the first place.

One must *use* his knowledge as did, for example, Leibniz and Hegel. But if assimilation proves unfeasible, then better a chemically imaginative Boyle than a mediocre scientist like John Twysden; better a Blake who "mocked on" Voltaire (an eighteenth-century scientific philosopher) or a Wordsworth, who *consciously* turned away from the shackles of Locke and Linnaeus, two of the most influential scientific minds upon poets of the early nineteenth century— than a tedious Erasmus Darwin or Richard Jago. Better in the sense that their works are useful to society and profitable to private citizens. True, we will never know what Erasmus Darwin's poetry would have been like without Linnaeus—or, for that matter, Jago's without the Burnet Controversy and the New Geology of the mid-eighteenth century—but if *The Botannic Garden* serves as an example, then better not to have had Linnaeus assimilated into English poetry at all. Many other examples are waiting to be plucked. Let one suffice: the appreciation of poetry will not make a chemist a better chemist; it may enrich his life and make him a more culturally well-rounded person, but the actual influence on his chemistry is dubious, at best. The moral shines clear through all these examples: science, in and of itself, does not make an artist a better artist, or vice-versa. Charles Darwin has stated the matter dramatically and succinctly in his *Autobiography* when commenting that his scientific research grew worse as he read more poetry and better when he stopped.[32]

These conclusions are admittedly perverse, and bending the facts to suit a trumped up generalization that "science and the arts have always marched hand in hand" sooner or later will be exposed as a fallacy concocted by a group of disenchanted academics who had an axe to grind. In isolated instances throughout the whole of history, cases do exist of tangible "assimilated influence" going one way (science to the arts) or the other (arts influencing science); but no general law can be extracted from this assertion since there are at least as many cases showing *no* influence as those that do. Nor can one judge either the quality of a particular work of art or achievement in science (e.g. an invention, discovery, scientific theorem) by its capability to have been influenced by the other, whether science or art.

Poetry, for example, like all other art, always succeeds in the same way: by virtue of enduring tides of taste and the vagaries of fashion. But a great poem, marble-like, outlives and perdures, eventually carves its own permanent niche and gains its fair recognition. As does a symphony or a great painting, a distinguished poem will eventually achieve its merited place in literature although it takes scores of years to discover its greatness.

There is no such phenomenon in reality as a great artist succeeding *only* for his own age: Shakespeare, Turner, and Handel have succeeded as have Harvey, Newton, and Rutherford—by the endurance throughout time of the merit of their works—and the extent of their achievement cannot be mapped out on a graph measuring their peculiar ability to be influenced by science, or in the case of the latter, by art. If sound research demonstrates such influence, this may enable us to understand better the particular artist or scientist, his development, career, blossoming, the conditions enhancing his work, and so forth, but it will not, indeed cannot, encroach upon our sense of his final achievement. If, therefore, it turns out in the future ages of man—to paraphrase Wordsworth's often quoted sentence in his *Preface to the Lyrical Ballads* (1798)—that scientists and non-scientists can do very well *sans* one another, ought we not to leave well enough alone? Ought we not then to admit that they are growing apart *au fond* and content ourselves that this development does not entail such a sad state of affairs after all, despite the myth of their having historically been handmaidens to one another?

VI. *THE FUTURE*

The signals are monolithically other than just predicted. Technology is no longer what she used to be, not even in 1959 when Lord Snow lectured. Who today (with the possible exception of Dr. Leavis who, in his most recent hysterical outburst with Lord Noel Annan has demonstrated that such anti-

scientific humanists like himself have lost the battle and are holding on to their last will and testament for dear life[33]) would deny technology's rewards? Would we be gathered in this room? Would we have been able to assemble in Edinburgh, having come from all the distant corners of the globe? Would this university have been able so splendidly and elegantly to house and board so many of us? Decidedly not. Consider and appreciate the problem of shepherding people over large distances in the Middle Ages. But also consider that the rhetorical questions here asked imply answers not completely straightforward. The superlative question latent here is not whether science and the arts have influenced one another—we know they have in certain cases, and have not in others—or even whether they *ought* to influence one another in the future. No, the question is *how* they can supplement one another and lead all of us hopefully to a richer cultural and emotional life than we now lead. No one who boasts sanity and sobriety would dream of banishing one or the other, and everyone knows how impossible it is to live through a single day without each. But not very many scholars, or even very many imaginative-minded persons, have inquired how science and the arts can nourish, encourage, and support one another. Our obsession with the past has caused us to focus on the war between them: the history of their rift. War implied factions, and historians proceeded, like Dr. Leavis, to trace the history of their impending separation: their storm and strife and finally the aftermath of the schism. The "other side" of their story, their marriage, as it were, has been left by the wayside, and whenever a book relating them (such as Wylie Sypher's *Literature and Technology*, 1969) is published, the emphasis always centers on their hostility. This conference itself has demonstrated the direction, at least in the announced topics and papers: a handful of examples to the contrary cannot offset a dominant trend revealing that most artists have despised science and technology and will probably continue to do so. If we look about us in the literary world, we can observe that only in literary history do the two become wedded. Science fiction, alone among the creative forms of literature published today, demonstrates the marriage. And yet not one speaker on this panel has taken the time to examine this rich art form, everywhere in the Western world so potentially important for the future of literature.

In the future, technology must necessarily be the mistress. She must reign supreme: for technology alone can feed the billions that will tread on the face of the earth, and technology alone, not poetry, can prevent terrestrial cataclysm and devastation. Riding on the crest of her wave together with all our other activities are the "two cultures"—although even to employ that phrase

now seems to indulge in a dead issue. But we must not lose sight of the "counter cultures" which, in 1972, loom as large in any discussion of the future, as science and the arts. The war now is between establishments and anti-establishments, between authority and dissent; and there is probably more truth to the supposition that scientists and artists, if employed and "established", are viewed by the counter sub-cultures as the enemy. Even if the counter cultures had not arisen in the Fifties and Sixties, there would still remain the problem of searching for the practical value of tracing the history of science and the arts. And here history is but a feeble teacher despite the beautiful energies of my learned colleagues who very soon will show you how science and the arts were once wedded in the Renaissance and even in the Enlightenment: sitting on one cushion, as Shakespeare would have said, a union in seeming partition. That union has disappeared, and the development, contrary to our intuition, may be a very happy development. If science has in the past, as Medawar has commented, tended to "expel" literature, then technology —to retain his rhetoric—today is "expelling" history.

If the rift continues, will the future stand to lose? Will culture be a more barren desert than at present? Will there be no oases? Probably not. The separation of science and the arts makes little practical difference: it is a theoretical construct of limited practical significance that has little effective application in daily life. We do not ask when dialing a number if the telephone itself is "science" or the "arts"; nor do most of us—although I am aware some of us do—question whether the telephone is good or bad: it is there; we accept this convenience, we all use it, and most of us are eternally grateful. Transposed to the study of individual disciplines (e.g. history, philosophy, the arts, physics, biology), rather than to gadgets, the same matter-of-fact process reveals itself. Specialization in our universities marches ahead, although insulation need not; specialization is powerful, profitable, and practical to all citizens of the state.

Other foreign lands must, of course, be sought out. It is part of the human condition continually to explore and hunt for new horizons. If we educators would advertise, for example, the advantages of cultural interchange between science and the arts as much as the present Conservative Government the Common Market, we shall have tapped a potential asset. English intellectual life here affords a unique opportunity, for it remains, unlike American, remarkably intimate. Perhaps England is the obvious country in which to start another kind of reformation other than religious: in this very old and very brilliant country, the particular combination of size and receptivity to

the new would seem the obvious place at which to start moving towards the twenty-first century.

But we must, especially the romantics among us, shed any sentimental or nostalgic notion of science and the arts magically fused into some hermaphroditic whole. We must never allow ourselves to be trapped into naively believing that science and the arts, once whole and sadly having grown separate, must now each be recalled from its involuntary exile and thrown together, haphazardly and just for the sake of retaining organic wholeness, into an artificial union. Sometimes fragmentation represents human progress and civilization, and that of science and art may be a case in point. Although we continue to say we can't, we *must* pause and reconsider what this particular relationship means for the future of mankind. And in so doing, we probably ought to rethink the whole question of the two cultures, an issue in itself now so dead that the college students I teach at present at the University of California conceive of it as they do the remote topics in Herodotus, Machiavelli, and Lord Acton. We, like Archimedes plunging bodies into water to observe what happens or like Descartes seated near his stove in "won'drous experiment", need to recover a sense of wanting to explore virgin territory. It is my emphatic hope that when this symposium next congregates, it will necessarily ramble into the future rather than concentrate exclusively upon the past; that it will explore the possible courses of future culture rather than the "antique history"—as Gibbon wrote when discarding irrelevant aspects of his *Decline of Rome*—of a somewhat dated hostility between two mythical cultures, or what some mindless souls will never perceive was in the first place merely a metaphor to describe the frustration and over-growing disenchantment of a small but decaying segment of the world's overall population, the intellectual Plantaganets.

NOTES

1. C. P. Snow, *The Two Cultures and the Scientific Revolution: The Rede Lecture, 1959* (Cambridge, 1959), p. 10.
2. Of the vast literature written on this subject, the best summary remains Theodore Roszak's *The Making of a Counter Culture* (New York: Doubleday, 1969).
3. *The Two Cultures*, p. 15.
4. *The Two Cultures*, p. 15.
5. See the balanced opinion of Gerald F. Else, *Aristotle's Poetics: The Argument* (Cambridge, Massachusetts, 1957).

6. See Benjamin Farrington, *Francis Bacon: Philosopher of Industrial Science* (London, 1951); and the many books by Paolo Rossi on Bacon's learning.
7. The reader interested in pursuing the fortunes of the Snow-Leavis controversy during the Sixties may wish to consult these works: F. R. Leavis, *Two Cultures? The Significance of C. P. Snow: The Richmond Lecture, 1962 with an essay on Sir Charles Snow's Rede Lecture by Michael Yudkin* (London, 1962) and C. P. Snow, *The Two Cultures: A Second Look* (Cambridge, 1963). Snow in his Rede lecture (1959), confined himself to statements about the non-communication of two types of education, scientific and artistic. The immediate context of his lecture was expansion of the British universities and the blueprints of a new curriculum for them. At no point did he focus on the two cultures in society-at-large.
8. There are, of course, exceptions; but these figures are so unrepresentative of our culture at large that they can be enumerated on a single page. Most are tucked away in high-ranking scientific or academic posts, for example, René Dubos at New York's Rockefeller Institute.
9. *The Two Cultures*, p. 10.
10. These influences have now been microscopically investigated: for Michelangelo, see Robert J. Clements, *Michelangelo's Theory of Art* (London, 1963) and Charles Morgan, *The Life of Michelangelo* (London, 1960); for Da Vinci, R. Marcolongo, *Leonardo da Vinci artista-cienziato* (Milan, 1939); E. Belt, *Leonardo the Anatomist* (Lawrence, Kansas, 1955); and Ivor B. Hart, *The Mechanical Investigations of Leonardo Da Vinci*, foreword by E. A. Moody (Berkeley and Los Angeles, 1963); for Milton, Marjorie Hope Nicholson, *Science and Imagination* (Ithaca, New York, 1962). The most learned of Leonardo scholars, Roberto Marcolongo, who has contributed the chapter entitled "Da Vinci's Mechanics" to the magnificent two-volume Da Vinci Memorial published by the Leisure Arts Press (Novara: Italy, 1964), has noted: (vol. II, p. 483) "When seen in those two aspects [as artist and scientist], the figure of Leonardo is not only immense: it is all but unique in the history of the development of scientific thought, the two sides being linked by closer and deeper ties than can be perceived at first sight, although the second of them, namely, Leonardo as an artist, has been studied in extensive works far more than the first aspect, and this has been true in all times and in all countries. There are few treatments that show us a complete Leonardo, Leonardo as a true and supreme artist-scientist, with a few exceptions such as the article in the *Enciclopedia Italiana*". Later on, Leonardo's reasons for aspiring to know about *both* science and the arts are explained. "I believe that Leonardo forced by events, by the circumstances of his life, by his competition with other artists, to engage in works involving all the branches of Renaissance engineering, realized, with the intuition of genius, the need for the preliminary theoretical re-

search that he compared to the captain, practice and applications being the soldiers". Elsewhere in the same volume Giuseppe Favaro, an expert on the relation of Leonardo's art to the biological sciences, has commented ("Anatomy and the Biological Sciences", 363-387) that "Leonardo seems not to have devoted himself to the deeper study of human anatomy from the outset, but, like other Renaissance painters, to have cultivated it solely for the purpose of forming a solid foundation preliminary to the study of art. He appears to have devoted himself to accurate anatomical investigation only later, attracted to it by his thirst for study and knowledge." (p. 363)

11. *The Two Cultures*, p. 18.
12. Goethe's achievement in both realms has been brilliantly studied by Phillip E. Ritterbush, "Organic Form: Aesthetics and Objectivity in the Study of Form in the Life Sciences", in *Organic Form: The Life of an Idea*, ed. G. S. Rousseau (London, 1972), pp. 00-00.
13. A lopsided view of Sherrington's literary achievement appears in C. E. R. Sherrington, *Charles Scott Sherrington 1857-1952* (London, 1957); a more realistic view is found in Baron Henry Cohen's *Sherrington, Physiologist, Philosopher and Poet* (London: The Sherrington Lectures, 1958).
14. Oddly enough, he was cheered by many of his colleagues who felt the same way but had not the conviction or courage to speak out.
15. See especially the two volumes entitled *The Life and Selections from the Correspondence of William Whewell* (London, 1881) as well as Todhunter's *William Whewell . . . with Selections from his Correspondence* (Cambridge, 1876).
16. Not a single Newton scholar has, to my knowledge, made a case for the influence. The most authoritative work on the subject is Frank Manuel's *Isaac Newton, Historian* (Cambridge, Massachusetts, 1963).
17. There is a large literature studying the two-way influence: see, especially, *Hegel's Science of Logic*, trans. W. H. Johnson and L. G. Struthers (London, 1928, 2nd ed.), The Muirhead Library of Philosophy; and J. N. Findlay, "The Philosophy of Nature", in *Hegel: A Re-Examination* (London, 1958), pp. 267-287.
18. Such statements, for example, as this: "Scientific Humanism can provide a real and lively basis for faith in the business of living, and also a spur to effort by reminding man that he is now the sole trustee for any further progress to be made by life" (*Humanism* by Julian Huxley, Gilbert Murray, and J. H. Oldham (London, 1944), p. 4. Has the case ever been otherwise since the dawn of recorded history? Or take this simple-minded and blindly naive assertion (*Humanism*, p. 5): "In the modern world science alone can provide the necessary basis for further advance."
19. See the biographies by T. M. Fries (1923), C. L. Brightwell (1858), D. C.

Carr (1837), and others going back to the late eighteenth century, all perpetrating the same story.

20. Cyril Darlington, *The Conflict of Science and Society: Conway Memorial Lecture* (London, 1948), pp. 40-41.
21. Shaw's treatment of science receives extensive treatment in William Irvine's *The Universe of G. B. S.* (New York, 1949), which discusses his dislike of doctors, dispraise of medicine, distrust of science generally, and concludes (p. 314): "Essentially, he is an armchair investigator, deriving his data from books, introspection, and literary analysis. He might also be called a vicarious, or parasitic experimenter, for he preys on the experiments of others . . ." If this constitutes "assimilation", then every author from Moses to Thomas Mann, from Beowulf to Virginia Woolf, has been a true man of "both cultures!"
22. This influence has recently been argued by George P. Elliot, "Science and the Profession of Literature", *The Atlantic Monthly* (October 1971), pp. 105-111, who views the influence as nothing less than disastrous.
23. *Encounter* (January 1969), p. 23.
24. For Harvey's collecting, see Geoffrey Keynes, *The Life of William Harvey* (Oxford, 1966), pp. 155ff., and the biography in the *Dictionary of National Biography*.
25. (London, 1648), pp. 155-156.
26. The actual passage reads: "Whence it happens that several persons abstract several species, and conceive different notions, from viewing the same object at the same time. This is conspicuous among poets and painters, who, although they contemplate one and the same object in the same place at the same moment, and with all other circumstances agreeing, nevertheless regard and describe it variously, and as each has conceived or formed an idea of it in his imagination. In the same way, the painter having a certain portrait to delineate, if he draw the outline a thousand times, he will still give a different face, and each not only differing from the other, but from the original countenance; with such slight variety, however, that looking at them singly, you shall conceive you have still the same portrait set before you, although, when set side by side, you perceive how different they are. Now the reason is this: that in vision, or the act of seeing itself, each particular is clear and distinct, but the moment the object is removed, as it is by merely shutting the eyes, when it becomes an abstraction in the fancy, or is only retained in the memory, it appears obscure and indistinct; neither is it any longer apprehended as a particular, but as a something that is common and universal."
27. This now has been superbly demonstrated by David Hackett Fischer in *Historians' Fallacies* (London, 1971).
28. If by "science", however, we mean an all-inclusive and non-restrictive terrain,

then every dunce can prove that it (i.e., science) influences everything else, especially every "art", because science here denotes everything.

29. Until recently books on science and literature, for example, have not made any attempt to define "science". Such works as Aldous Huxley's *Literature and Science* (1963) appear in great numbers, merely surveying the distinct aims of literary and scientific writing. An example is Douglas Bush's *Science and English Poetry* (Oxford, 1950), in which "science" includes everything not distinctly literary. More recent collections—e.g , Edward M. Jennings' *Science and Literature: New Lenses for Criticism* (New York, 1970)—are beginning to reject the older type of writing and sharpen their definitions; but the term *science* remains blurry and requires further refinement, as does the wide range of problems raised by their interrelations.
30. Any reader who doubts the assertion should consult Roszak's *The Making of a Counter Culture* (1969), as well as Christopher Jencks and David Riesman, *The Academic Revolution* (New York, 1968), and, more recently, Jean-Francois Revel's *Without Marx or Jesus* (New York, 1971), the sections dealing with the alienation of America's young.
31. Cyril Darlington, *The Conflict of Science and Society: Conway Memorial Lecture* (London, 1948), p. 18.
32. *Autobiography of Charles Darwin*, ed. N. Barlow (London, 1958), p. 138.
33. See G. S. Rousseau, "Quality or E-Quality in the Universities: Some Meditations on the Leavis-Lord Annan Controversy", *Arts in Society: Search for Identity and Purpose*, VIII (1971), pp. 342-351.