The Two Cultures in the New Millennium

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THE TWO CULTURES IN THE NEW MILLENNIUM

At the traditional hour of five o'clock on the afternoon of 7 May 1959, a bulky, avuncular figure approached the lectern in the Senate House of the University of Cambridge. The speaker was Charles Percy Snow (more formally known as Sir Charles) and the occasion the annual Rede lecture, an important event in the Cambridge academic year. Sir Charles was a man of diverse background: he had been a research scientist, had held high-level administrative posts in the Civil Service and in private industry, and in addition was the author of a series of novels that told of the intrigues and struggle for power within academic and government circles. As one who had attained a significant notoriety in public life, he could be expected to give oracular pronouncements on all manner of subjects. This day he took as his theme a topic that recalled explicitly a Rede lecture delivered in that very place in 1882 by the famous Victorian man of letters, Matthew Arnold. The title of that discourse was "Literature and Science." Snow's lecture was entitled "The Two Cultures and the Scientific Revolution." This talk had immense repercussions in the intellectual community of England and America especially, but also of Europe generally, and gave rise to various culture wars in which we

are still engaged. Most commentators--whether favorable or unfavorable—admitted that he had touched a sensitive nerve.

The address begins informally, almost like a friendly *causerie*. Snow does not pretend to any particular qualification for expatiating on such a subject except that he himself had experience in both camps. "By training I was a scientist; by vocation I was a writer,"[1] he says modestly. As he goes on to reminisce, it is clear that it was his scientific side that gave him most pride. At Cambridge he had a ringside seat at one of the most creative periods in all of physics, he confides, with reference to the famous experiments at the Cavendish Laboratory. His literary activities brought him into the company of writers. Of these meetings he remarks casually: "There have been plenty of days when I have spent the working hours with scientists and then gone off at night with some literary colleagues."[2] (It should be noted that "gone off" is British slang for a trip to the pub). The comparison between the two facets of his life is rather patronizing, to say the least. In this double life, Snow began to conclude that the two groups had little in common. Though comparable in intelligence and not grossly different in social origin, they could not communicate with each other. This is his trenchant description of the situation: "Literary intellectuals at one pole–at the other scientists, and as the most representative, the physical scientists. Between the two a gulf of mutual incomprehension–sometimes, (particularly among the young) hostility and dislike, but most of all lack of understanding. They have a curious distorted image of each other."[3] This dichotomy he labels the two "cultures," using the word loosely in a quasi-anthropological sense as if he were talking about two tribes. The designation stuck.

As Snow continues in his analysis of the characteristics of the two groups, it becomes ever more obvious where his true sympathies lie. In the mutual

accusations commonly exchanged between the two cultures, the scientists are often branded as shallow optimists. Snow comes to their defense saying that they are more concerned with social conditions than most twentieth-century literary figures. He returns to this theme more emphatically in the last part of his lecture, which in the published edition bears the subtitle "The Rich and the Poor." Technology is the only thing that can remedy this disparity, and Snow believes that the learning of technology is within the grasp of everyone. The proof of this, for him, is the rapidity with which the Russians and the Chinese were able to produce the atom bomb. Using a rather crude expression smacking of crass materialism, Snow remarks: "Jam today and men aren't at their most exciting; jam tomorrow, and one often sees them at their noblest."[4] In this same condescending mood he says that he has found Sicilian girls taking the top places in the Honors Physics course at the University of Rome, as if Sicilian "girls" were some kind of sub-species of the human race. Snow's real concern in this critical period of the Cold War was that the Russians through their educational policies had a clear edge in the number of trained scientists and engineers they could send to the Third World. "Asians and Africans," he says, "want men who will muck in as colleagues, who will pass on what they know and get out. Fortunately this is an attitude which comes easily to scientists."[5] Then, in an extraordinary string of dubious platitudes, he asserts confidently: "They are freer than most people from racial feeling; their own culture is in its human relations a democratic one. In their own internal climate, the breeze of the equality of man hits you in the face, sometimes rather roughly, just as it does in Norway."[6] There must have been a chorus of snickers through some sectors of the crowd to greet this *boutade.*

If this exalted depiction of the scientist as a sort of demi-god seems exaggerated, one has only to look at the first draft of "The Two Cultures" as it appeared in the *New*

Statesman, October 6, 1956. The kid gloves are off. The traditional culture–which he equates with the literary culture–must give way to the new age of science. The scientists are confident that history is on their side; they sense that they are the directing class of a new society ("the new men," Snow calls them in the title of one of his novels). They are real men, heterosexuals, not "feline and oblique." (This not so oblique designation of the man of letters was prudently omitted from the public lecture.) The piece ends in a grand peroration: "Defeat, self-indulgence, moral vanity–from such qualities the scientific culture is almost totally immune. It is the moral health of science that we need."[7]

These heroic sentiments are somewhat toned down in the public lecture, but the scientists are still the children of light. Snow admits, for one thing, that all scientists do not think alike and do not always understand each other, but he hastens to add: "If I were to risk a piece of shorthand, I should say that naturally they had the future in their bones."[8] Where does this put the traditional culture, as he calls it? His answer: "If the scientists have the future in their bones, then the traditional culture responds by wishing the future did not exist."[9] In a note to the published edition, Snow cites the example of George Orwell's *1984*[10]; but his own idol, H. G. Wells, for all his futuristic hopes, also had misgivings about the future, as evidenced in his later works, such as the eerie ***Island of Dr. Moreau*** and ***Mind at the End of Its Tether***. It is not that Orwell wished that the future did not exist, but that a certain kind of future in which science, among other things, could become an instrument of repression, did not exist.

Snow gives as an example of the mutual incomprehension between the two cultures his own personal experience in interviewing thousands of scientists and professional engineers for jobs. To his amazement he discovered that many of them, when asked what they read

or thought about, modestly confessed that they may have "tried" a little Dickens, as if he were some esoteric and dubiously rewarding author. Yet this is accounted as a pardonable peccadillo compared to the monumental ignorance of literary persons about the world of science. Snow's disdain is made apparent in his choice of an injurious analogy: "It is rather as though, over an immense range of intellectual experience, a whole group was tone-deaf. Except that this tone-deafness doesn't come by nature, but by training, or rather the absence of training."[11] In other words, the literary world's insensitivity to scientific concepts is a culpable ignorance, purposely cultivated. To reinforce his point, Snow gives a more concrete example. He recounts how when present at gatherings of people who, by the standards of the traditional culture were thought to be highly educated, and some of them began ridiculing the illiteracy of scientists, he would counter by asking how many of them could describe the Second Law of Thermodynamics. His question would invariably fall upon deaf ears. Yet he considers this as the scientific equivalent of asking, "Have you read a work of Shakespeare?" The comparison is manifestly inappropriate. The two things are incommensurable. An educated person, scientist or not, should be able to have some understanding of a play of Shakespeare. Without a specialized training in literature, one may not be able to appreciate fully the beauty of form or language, the dramatic art, the construction of plot, but the ordinary reader or viewer can catch something of Shakespeare's analysis of character and of the human condition. Whereas even to begin to understand physical laws, whether it be the Second Law of Thermodynamics or the concepts of mass and acceleration, requires a long, arduous training and a mastery of the complex language of science, *viz.*, mathematics. A different mind-set is required, adept at analyzing a series of logically coherent hypotheses validated by experiment and empirical observation.[12]

In addition to his charge of willful ignorance in these matters on the part of the "traditional culture," Snow proceeds to make an even harsher indictment. In the published version of the talk, the second section bears the provocative title "Intellectuals as Natural Luddites." Snow refers to the refusal or inability of literary intellectuals to understand the significance of the Industrial Revolution. The term Luddites, more familiar in England than America, refers to gangs of English workingmen who at the beginning of the nineteenth century set themselves to destroy textile machinery in the midlands and north of England, taking their name from a half-insane, mythical character named Ned Ludd. Snow says in so many words that writers didn't comprehend what was happening in the early days of the Industrial Revolution: "Plenty of them shuddered away, as though the right course for a man of feeling was to contract out."[13] He would imply that the hideous back streets, the smoking chimneys, the human misery was too much for their fastidious natures. Snow mentions some of these callous writers by name: John Ruskin, William Morris, Henry David Thoreau, Ralph Waldo Emerson, D. H. Lawrence. These are the men, according to Snow, who could not stretch their imaginative sympathy to the plight of the down-trodden. Yet in the next breath Snow forgets the social consequences of this hard-won "progress" and proclaims, "One truth is straightforward. Industrialization is the only hope of the poor."[14] It may be remarked that this utopian sentiment is still widely shared in the modern scientific community. Snow mocks the idealism of a Thoreau saying, "It's all very well for one, as a personal choice, to do a modern Walden, if you like . . . but not to impose this choice on others who are not free to choose."[15] The venom of this attack upon the "literary intellectuals," again his term, is plainly palpable. But what he says could hardly be further from the truth. Writers of the nineteenth century certainly *did* see what was happening, and they did not like what they

saw. The very writers he names—Ruskin, Morris, Lawrence—and others, such as Thomas Arnold, Charles Dickens, Samuel Taylor Coleridge, John Stuart Mill, did not turn away with "screams of horror," as Snow accuses, but raised their voices in protest, calling attention through their writings to the misery around them and serving as instruments in bringing about a change in those pitiful social conditions.

In the third part of his discourse Snow comes to the twentieth-century scientific revolution which he distinguishes from the industrial revolution by its application of "real science," as he calls it, to industrial uses. This leads to a discussion of the ever-widening gap between pure and applied scientists and to the problem of how this new knowledge can be incorporated into the educational system. Snow is painfully aware that in the era of the Cold War, the Soviet Union was forging ahead dramatically in the training and production of engineers. He could speak from personal experience in this regard, having traveled extensively in the Soviet Union and conferred with Russian scientists. At times Snow seems to betray a certain sympathy for the Marxist system. He notes that the engineer enjoyed a much higher social status in the Soviet Union, as was reflected in Soviet novels, in which novelists could presume at least a rudimentary acquaintance with modern industrial civilization on the part of their readers. It is significant, however, that he fails to mention the subservience of the writers of social realism to the dictates and censorship of the ruling regime.

At the end of his address, Snow admits that his schemes may be too idealistic. He has not taken into account human nature with all its foibles. These super-heroes that he envisions are subject to the same selfish interests and weaknesses as other men. He admits also that he does not know what political techniques will be employed to achieve his goals, but one thing is certain: the gap between the two cultures must be closed, "for the sake

of the western society living precariously rich among the poor, for the sake of the poor who needn't be poor if there is intelligence in the world."[16] For these reasons, he concludes, it is necessary to look at our educational system with fresh eyes.

The facile polarization that Snow posits contains obvious fallacies. At one moment the traditional culture seems to refer to the literary intellectuals, but, as the talk progresses, it is obvious that the pejorative term extends to all non-scientific intellectual pursuits. At the same time he chooses to ignore the rifts that divide the scientific community itself. Even the non-scientist is aware of the growing lack of comprehension that exists among the various sciences and their numerous sub-disciplines. Likewise, Snow says nothing of the fine arts and music, law and economics, not to speak of what might be considered a third culture—sociology.

As a prominent member of the British Establishment, a man who had fulfilled important roles both in the Civil Service and in private industry, Snow could speak with great authority, literally *ex cathedra*. The lecture was published immediately in the June and July issues of the leftist review ***Encounter***, then as a book which had ten reprintings in three years, and later both in England and America, as a paperback, which was reprinted sixteen times in the next twenty years. Early reactions were overwhelmingly favorable. Snow was congratulated in England and abroad for having diagnosed an increasingly pressing modern problem. On this wave of success, Snow wrote a few afterthoughts in the very next year, 1960, again in ***Encounter***. He was happy that his concept of the two cultures and the gulf that separated them had been accepted. The villains in the story were still the literary crowd, who had encouraged an undiscriminating and ultimately selfish hostility to the new scientific revolution, as they had done in the past. By posing as one familiar with both camps, he claimed to

offer personally, as it were, a quality guarantee for his words.

There were some dissident voices as well, but the storm would break with hurricane force three years later at a similar university lecture in Cambridge—the Richmond Lecture at Downing College, delivered by the famous literary critic, F. R. Leavis. There could hardly be a figure more diametrically opposed to Snow's ideas and personality than this controversial, anti-establishment, passionate advocate of the role of literature and literary criticism in English society. The attack is unmitigatedly ferocious, which is rather unfortunate because the manner detracts from the message and obscures the larger significance of the issue. It opens with a devastating salvo against the authoritative and complacent tone of Snow's utterance: "If confidence in oneself as a master-mind [it should be noted here that one of Snow's novels was called *The Masters*] qualified by capacity, insight and knowledge to pronounce authoritatively is genius, then there can be no doubt about Sir Charles Snow's. He has no hesitations."[17] Leavis proceeds to ridicule the speaker's complete lack of modesty combined with a monumental ignorance of history, of the history of civilization, of literature. Leavis says that one could dismiss Snow as altogether negligible if he were not a portent of things to come, created by a new cultural elite as a master-mind and sage. The Cambridge critic explains that he would have ignored this phenomenon except that he saw that the essay was quickly becoming a classic and was even adopted as required reading for sixth-form students, foisted upon Britain's future educated class.

In rebutting Snow's views Leavis spends too much time in crude *ad hominem* arguments deriding Snow's reputation as a novelist. Leavis accuses him of not knowing what a novel is, saying that Snow's characters lie dead on the page, that the dialogue cannot be imagined as being spoken. In a humorous aside Leavis says that he has heard somewhere that the novels are composed for Snow

by an electronic brain called Charlie, into which chapter-headings are fed.[18] In a more serious vein Leavis inveighs against the egregious charge of "natural Luddites" levelled at the representatives of the traditional culture. He considers it as a general indictment against all those who would have other concerns about the future of humanity than concerns that have to do with productivity, material standards of living, hygiene, and technological progress. He exposes the emptiness of such clichés as "social hope" and "jam tomorrow." These material concerns are not enough, "disastrously not enough."[19]

It is not that Leavis would wish to reverse the irreversible advance of technology, thereby truly becoming a modern Luddite. He is concerned about the creative human response that will be needed to deal with these changes. With almost prophetic vision of our present situation he says: "The advance of science and technology means a human future of change so rapid and of such kinds, of tests and challenges so unprecedented, of decisions and possible non-decisions so momentous and insidious in their consequences, that mankind—this is surely clear—will need to be in full intelligent possession of its full humanity."[20]

Leavis's scathing remarks evoked a storm of protest from many of Snow's adherents in letters to ***The Spectator***, where Leavis' lecture was published. Snow himself responded in the next year, 1963, with "The Two Cultures: A Second Look." In the grand manner, Sir Charles does not deign to refer by name to his opponent or to the lecture. He defends at some length his own conception of the two cultures, but admits that in his English insularity he was unaware of the development of what might be considered a third culture, more conspicuous in America. He refers to such fields as social history, sociology, demography, political science, economics, government, psychology, and medicine, which might be able to effect some kind of rapprochement

between the two cultures. In rethinking his example of what might pass as unforgivable ignorance on the part of the non-scientist, he would now choose molecular biology rather than the Second Law of Thermodynamics since, as he says, molecular biology does not involve serious conceptual difficulties and needs very little mathematics to be understood. Snow sticks to his belief in the social and humanitarian benefits of the scientific revolution for the underprivileged and brings forth statistical studies to demonstrate the appalling living conditions of pre-industrial times. He has not changed his view on the anti-social and anti-progressive ideas of certain writers of the nineteenth century, singling out this time Dostoevsky's *Diaries* as a blatant example of the most horrifying reactionary propaganda. In the end, Sir Charles admits that changes in education are not going to produce miracles but that it is dangerous to have two cultures that cannot or will not communicate.[21]

In the political sphere Snow had some victories. He endorsed the ***Robbins Report***, which was responsible for major reforms in the curricula and expansion policies in British university education in the '60s, and he was instrumental in furthering the establishment of Colleges of Advanced Technology. Against the critics who objected that "more means worse" and that expansion could only be achieved at the cost of falling standards, Snow remained on the side of policies of vigorous expansion.

Aldous Huxley tried to heal the breach with an essay on literature and science,[22] in which he emphasized the public nature of scientific investigation as against the more private world of the sentient, self-conscious literary artist. The scientist attempts to reduce the enormous multiplicity of physical phenomena to some kind of unity and rational order while the literary artist takes it upon himself to create an uncommon language to express the richness of inner experience, in the words of Stéphane Mallarmé, "donner un sens plus pur aux mots de la tribu"[23]

(to give a purer sense to the language of the masses).

Snow's lecture and Leavis's response were, in reality, a twentieth-century re-enactment of a famous debate that took place in the late Victorian period. The protagonists then were the biologist Thomas Henry Huxley, "Darwin's bulldog," as he was named for his staunch defense of Darwin's theories, and Matthew Arnold, poet and literary critic, and also one of Her Majesty's Inspectors of Schools for over thirty years. Their exchanges were much more amicable and gentlemanly than the twentieth-century epilogue. The two men respected each other; they were of the same social class and were members of the same exclusive club, the Athenaeum, in London. Huxley was convinced of the educative value of scientific knowledge. According to his way of thinking, science, not literary culture, supplied the practical model necessary for a practical age, and could also become the basis of its ethical assumptions. As the physical world was governed by certain laws, so was the moral world, and if one could discover these laws in the same methodical way as one investigated the physical laws, mankind could live in harmony with nature. In an address, entitled "A Liberal Education and Where to Find it," given to the South London Working Men's College, he intones a great paean of praise to the new scientifically trained child of nature:

> That man, I think, has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine with all its parts of equal strength and in smooth working order; ready like a steam engine, to be turned to any kind of work and spin the gossamer as well as forge the anchors of the

> mind; whose mind is stored with a knowledge of the great and fundamental truths of Nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of Nature or of art, to hate all vileness and to respect others as himself.[24]

Quite an extraordinary act of faith in *homo mechanicus* and the forces of nature, a lyric and fervent outburst hymning the mechanistic view of the universe, which smacks almost of idolatry.

This was the year 1868. Twelve years later Huxley delivered himself of another oration entitled "Science and Culture," this time at the inauguration of the Birmingham Science College. The founder, Sir Josiah Mason, had stipulated that theology, party politics, and "mere literary instruction and education" were to play no part in its curricula. Huxley challenged the monopoly of literary culture, specifically, classical culture, rightly pointing out that the modern humanists ignored an important aspect of the Renaissance, the discovery of Greek science: Euclid, Ptolemy, Archimedes. Huxley did not deny the merits of a classical education, if these subjects were taught as they should be: "if boys and girls were instructed in Greek and Latin, not merely as languages, but as illustrations of philological science, if a vivid picture of life on the shores of the Mediterranean two thousand years ago were imprinted in the minds of students."[25] But he insisted that they should not be the basis of a liberal education in the present day. In a rather absurd scientific analogy he compares the teaching of the classics to making paleontology the backbone of a modern education. On the other hand, he sensibly advocated the introduction of French and German, especially the latter, for the study of science.

Arnold responded in his Rede Lecture, "Literature and Science," at Cambridge on June 14, 1882, before a crowded audience in the same Senate House where Snow would give his discourse. It was temperate in tone, as Huxley's had been. Arnold began by acknowledging that science was an important part of education and could be a delight to the mind, but that it would leave out of account the powers "which go to the building up of human life . . . the power of conduct, the power of intellect and knowledge, the power of beauty, and the power of social life and manners."[26] For that reason he parts company with Huxley on the matter of making the training in natural science the main part of education, at least as far as the greater part of humanity is concerned. Arnold refutes his opponent's charge that literary culture refers only to elegant *belles lettres*. In his view the term comprises all the great writers in all fields: Newton, Galileo and Copernicus, as well as Plato and Sophocles; not merely Latin literature, but Rome's political, legal and administrative achievements, Greek art and science, in a word, "the best that has been thought and said in the world," to use the famous phrase from his earlier essay, "The Function of Criticism in the Present Time."[27]

In a conciliatory tone Arnold states: "There is really no question between Professor Huxley and me as to whether knowing the great results of the modern scientific study of nature is not required as a part of our culture as well as knowing the products of literature and art. But to follow the processes by which those results are reached, ought, say the friends of physical science, to be made the staple of education for the bulk of mankind."[28] Arnold asserts, on the contrary, that scientific studies furnished only instrumental knowledge, producing narrow-minded specialists. Human nature does not require merely to know but wants to *understand* what it has learned and grasp what effect this knowledge has on living one's life. Arnold knew that he could say such things without

offending Huxley, who himself had attacked those Goths and Vandals who wanted to banish everything from the curricula except scientific disciplines. Arnold concludes his lecture optimistically: "There will be crowded into education other matters besides, far too many, but humane letters will remain."[29]

In Arnold's tour of America in the following year he gave a modified version of this lecture everywhere he went, to the acclaim of crowded audiences.[30] In these days of cultural anarchy under the guise of multiculturalism, or as the Australian art critic Robert Hughes calls it, "multiculti," and of the rampant ascendancy of science, his words might still prove salutary.

A few years ago another important contribution to the debate about the two cultures appeared from the scientific side. To my mind it is much more insidious to cooperation and understanding among the various disciplines of learning than Snow's bland scientism. It is a work of the Harvard entomologist, Edward O. Wilson, to which he gives the rather esoteric title, ***Consilience***, with the explanatory subtitle, ***The Unity of Knowledge***. The word "consilience," derived from a putative Latin word (non-existent in classical Latin) that means literally a "jumping together," was coined by the scientist and polymath, William Whewell, in his two-volume treatise, ***The Philosophy of the Inductive Sciences***, published in 1840. Whewell defines the term in the second volume of his work: "The Consilience of Inductions takes place when an Induction, obtained from one class of facts, coincides with an Induction, obtained from another different class. The Consilience is a test of the truth of the theory in which it occurs."[31] Whewell further explains that concepts change and become integrated into new facts, as in the example of Newton's use of Kepler's laws to explain the central force of the sun. In Whewell's exposition, this consilience of inductions is a logical procedure in classical scientific methodology from what he

calls a "colligation" of facts. Wilson uses the term "consilience" in an absolute and abstract sense, omitting the modifier "of inductions," almost as if the word itself would magically bring about the unification he desires. As one reads through Wilson's disjointed book there is much leaping about, to revert once again to the connotation of the title, indeed quantum leaps from the molecular world to human behavior, often with no perceptible logical nexus.

From the beginning of his discussion, Wilson claims consilience for the natural sciences and the explorations of the material universe. Edward O. Wilson is a convinced, militant materialist and proud of it. If some people charge him with reductionism or scientism he pleads "guilty, guilty, guilty."[32] Wilson embraced this philosophy, as he candidly tells us, in reaction to his being raised as a Southern Baptist in Alabama, from which upbringing evolutionism liberated him forever. The further one reads into Wilson's scheme of consilience, the more apparent it becomes that rather than a *consilience*, he envisions an *absorption* of the social sciences, humanities and creative arts into one scientific culture. Philosophy is the first to fall. He proclaims confidently: "Philosophy, the contemplation of the unknown, is a shrinking dominion. We have the common goal of turning as much philosophy as possible into science."[33]

Before examining the tenets of Wilson's latest book it is essential to trace the evolution of his thought in his earlier writings. He himself speaks of a trilogy: ***The Insect Societies*** (1971), ***Sociobiology*** (1975) and ***On Human Nature*** (1978). The first book is an important contribution to the study of social insects, especially ants and termites.[34] (Wilson's first scholarly ambition was to classify the ant population of Alabama.) At the end of that book he makes the following astonishing reflection: "Had vertebrates gone the same route, the results would have been much more spectacular. The individual bird or

mammal, possessing a brain vastly larger than that of an insect, might have been shaped into a comparably better specialist. The vertebrate society then could have evolved into an unimaginably more complex, efficient unit – at the price, of course, of independent action on the part of its members. Vertebrates have instead remained chained to the cycle of individual reproduction.This forever enhances freedom on the part of the individual at the expense of efficiency on the part of the society. The dilemma of mankind is that technology and population growth have propelled us to the point where we could perhaps operate better as a society with termite-like altruism and regimentation, yet we cannot and must not forsake the primate individuality that brought us to the threshold of civilization in the first place."[35] He then goes on to envision a science that might study social behaviors that are similar in degree of complexity and convergent in many important details.

This is the genesis of ***Sociobiology***, the "Modern Synthesis," in which Wilson lays his neo-Darwinian evolutionary cards on the table. The book was heralded a month prior to its appearance in a front-page story in the ***New York Times*** as the establishment of a new scientific discipline that "carries with it the revolutionary implication that much of man's behavior toward his fellow man may be as much a product of evolution as the structure of the hand or the size of the brain."[36] Wilson himself followed this up with an article in the ***New York Times Magazine***, in which he stresses the social amelioration that will result from these studies. In the opening pages of the book he defines the new science as "the systematic study of the biological basis of all social behavior,"[37] and assures us that it will be confined at first to animal societies and the social behavior of early man. Yet at the end of the book, after twenty-six chapters of minute discussion and observation of behavior in various living organisms, Wilson turns to the later history of man.

Chapter twenty-seven begins with this nonchalant generalization: "Let us now consider man in the free spirit of natural history, as though we were biologists from another planet completing a catalog of social species on Earth. [Would that this were the case, but our extra-planetary free spirit turns out to be none other than Wilson himself.] In this macroscopic view, the humanities and social sciences shrink to specialized branches of biology."[38]

So we have Wilson's unambiguous classification of knowledge, what he will later euphemistically call consilience. There is nothing new in Wilson's basic theories. His New Synthesis harks back to the Enlightenment dream of intellectual unity and the vision of unlimited human progress. One of his heroes from this era is the Marquis de Condorcet, last of the *philosophes*, who towards the end of his life wrote a ***Sketch for a Historical Picture of the Human Mind.*** Herbert Spencer, champion of social Darwinism, similarly aspired after a synthetic philosophy, of which his ***The Principles of Sociology*** and ***The Principles of Ethics*** are a part. It is strange that Wilson rarely mentions Herbert Spencer, although Wilson's theory of social behavior is very much like Spencer's ideas of super-organic evolution, *i.e.*, the social molding of the individual character to fit social and cultural requirements. Wilson no doubt wished to avoid the disrepute associated with Spencer's views on the survival of the fittest, a phrase which Spencer had coined. For Spencer, poverty and starvation were natural agents cleansing society of the unfit. In the ***Study of Sociology***, Spencer asserts that "every society displays phenomena that are ascribable to the characters of its units."[39] This sounds very much like Wilson's thesis: "Behavior and social structure, like all other biological phenomena, can be studied as 'organs,' extensions of the genes that exist because of their superior adaptive value."[40] Just as in the case of Spencer, who passes in a great leap from the

behavior of an individual to aggregates of human beings and eventually, without warning, to society, so Wilson leaps from genes to social behavior with no apparent linkage. Like Spencer too, Wilson wishes to establish rules of right conduct based on scientific principles, a scientific morality, to replace jaded religious beliefs.

Grave social and political implications are inherent in the principles of the newly invented discipline of sociobiology. It posits that the social behavior of people, including such traits as homosexuality, aggression, or even conformism, are largely determined by our genes. If this is so, then the present structure of society might be considered the outcome of a natural process. It is all in the genes. "The anatomical, physiological and behavioral machinery . . . carries out the command of the genes."[41] Legal systems are outmoded. We are driven to act by biological predispositions; there is no individual responsibility. A group of Wilson's own colleagues at Harvard, many of Marxist persuasion, headed by population geneticist Richard Lewontin, the paleontologist Stephen Jay Gould (1941-2002), and others in the Boston area, was quick to seize upon the political implications of Wilson's ideas as a defense of the modern capitalist status quo and organized a Sociobiology Study Group of Science for the People in opposition to Wilson's theories.[42] They did so in a very strident manner in the pages of the ***New York Review of Books***, accusing him of racism and even linking his concepts with Nazi racial science, which is manifestly unfair. As a matter of fact, however, in the final pages of ***Sociobiology***, Wilson makes certain dire predictions that raise the ugly spectre of social engineering:

> The transition from purely phenomenological to fundamental theory in sociology must await the full neuronal explanation of the human brain. Only when the machinery can be torn down on paper at the level of the cell and put together again will the

> properties of emotion and ethical judgment come clear. Simulations can then be employed to estimate the full range of behavioral responses and the precision of their homeostatic controls. Stress will be evaluated in terms of the neurophysiological perturbations and their relaxation times. Cognition will be translated into circuitry. Learning and creativeness will be defined as the alteration of specific portions of the cognitive machinery regulated by input from the emotive centers. [Biobabble, which may be interpreted to mean the end of the humanities and social sciences as such.][43]

Having cannibalized psychology, the new neurobiology will yield an enduring set of first principles for sociology. So much for the social sciences!

Ah, brave new world! But that is not all. Evolutionary sociobiology has two more roles. "If the decision is taken to *mold* cultures to fit the requirements of the ecological steady state, some behavior can be altered experientially without emotional damage or loss in creativity. . . . The second contribution of evolutionary sociobiology will be to *monitor* [emphasis added] the genetic basis of social behavior."[44] Such are the appalling conclusions of Wilson's new science.

Sociobiology is a huge tome replete with the usual scientific apparatus: equations, graphs, statistics, drawings and photographs. It was reissued by Harvard in the year 2000 to commemorate the book's twenty-fifth anniversary: ***Sociobiology at Century's End.*** Wilson wrote a preface to this edition, in which he does not retreat one iota from his position. He still speaks of consilience, but the borderlands between the various disciplines, as he defines them, are still solidly in the scientific field. These borderlands are: 1) the neurosciences, which have supplanted the philosophic speculations of the past;

2) neuropsychological genomics, which narrow the mind-body gap still further; 3) evolutionary biology [including, of course, sociobiology]; and 4) behavioral ecology. The exact process of gene-culture coevolution, a subject which he had attempted unsuccessfully to resolve in ***Genes, Mind and Culture: The Coevolutionary Process***, he now relinquishes as the essential problem of the social sciences and much of the humanities.[45]

In 1978 Wilson published the last book of the trilogy, ***On Human Nature***, a pared-down, much more readable version of the same material. He announces his deterministic thesis in the opening pages: "No species, ours included, possesses a purpose beyond the imperatives created by its genetic history."[46] Its conclusion is even more apocalyptic than what he had hinted at in the previous book. As the genetic foundation of human behavior accumulates, "techniques may become available for altering gene complexes by molecular engineering and rapid selection through cloning. At the very least slow evolutionary change will be feasible through conventional eugenics. The human species can change its own nature."[47]

After this trilogy Wilson joined forces with a British scientist from the University of Toronto, Charles J. Lumsden. The fruit of this collaboration was ***Genes, Mind and Culture: The Coevolutionary Process*** (Cambridge, Massachusetts, 1981), a scientific monograph that attempted to explain the difficult matter of the translation of the genetic evolution of the mind into the evolution of culture. The writers called this process gene-culture coevolution, which they say comes about through epigenetic rules that are rooted in the particularities of human biology and that influence the way culture is formed. They must postulate a basic unit for a relatively homogeneous group of mental constructions or their products, to which they give the odd name *culturgen*. This term, we are told, is modeled on the term "artifact type" commonly used in archaeology. It is defined as "an array

of transmissible behaviors, mentifacts [sic!], and artifacts."[48] These mental constructions, or culturgens, can be anything from tools, taboos or dreams, to a child's disliking spinach or male philandering. Thus, *culture is the sum of the genetically controlled behaviors of individuals* [emphasis added]. Epigenetic rules are translated into "mass patterns of mental activity and behavior."[49]

This kind of gratuitous invention of terminology seems to have a bogus quality about it that is proper neither to biology nor anthropology. As he had done in his trilogy, so Wilson again provides a more personal and accessible account of his theories in another book (also written in collaboration with Charles Lumsden), called ***Promethean Fire*** (Cambridge, Massachusetts, 1983). At the end of the first chapter the authors concede that the extraordinary powers of the human mind might possibly be the result of the intervention of the hand of God. This they would term "orthogenesis," straight-line or directed evolution. But to admit this possibility would be to abandon the search just as their final goal was in reach. It is this difference of viewpoint, *i.e.*, between a materialistic and a spiritual concept of the mind, they say, that causes the gap between the two cultures, and they admit that "some distinguished and careful thinkers in both fields of endeavor consider the difference to be permanent, a discontinuity grounded in epistemology."[50] This sober reflection leads them to formulate their own answer: gene-culture evolution. But listen to their mythic and inspired explanation:

> We believe that the secret of the mind's sudden emergence lies in the activation of a mechanism both obedient to physical laws and unique to the human species. Somehow the evolving species kindled a Promethean fire, a self-sustaining reaction that carried humanity beyond the previous limits of biology. This largely unknown evolutionary

> process we have called gene-culture coevolution: it is a complicated, fascinating interaction in which culture is generated and shaped by biological imperatives while biological traits are simultaneously altered by genetic evolution in response to cultural innovation.[51]

Their demiurge is obviously a scientific form of God, an entity they are determined to discover by physical investigation. The conclusions of this exercise in unprovable hypotheses are predictable. They could have been written by Herbert Spencer and may be summarized as follows: all domains of human life, including ethics, have a physical basis in the brain and are part of human biology. Most or all forms of perception and thinking are biased by processes in the brain that are genetically programmed. The structure in mental development appears to have originated over many generations through a specialized form of evolution.

This brief rehearsal of some of the salient features of E. O. Wilson's thinking is necessary for the understanding of his notion of consilience, which he considers as an Ionian Enchantment, likening his quest to that of Thales of Miletus and the other Ionian philosophers of the sixth century B.C. who tried to discover the natural laws that governed the universe. Wilson's chief inspiration, however, is not the Greeks but the Enlightenment thinkers and their concepts of the potential of indefinite human progress and the intrinsic unity of knowledge: "the greatest enterprise of the mind has always been and always will be the attempted linkage of the sciences and humanities."[52]

In Wilson's view, the field will be divided between the sciences and the humanities, especially the creative arts. The social sciences he relegates entirely to extinction, one part fusing with biology and the other with the humanities. As we read on, however, it becomes plainly

apparent that consilience has nothing to do with conciliation, but means that all disciplines will be subsumed under one umbrella of pure physicality in which everything will fit into a seamless web of causal explanation. The no man's land where the natural sciences and what we might call the human sciences meet is the study of culture. Wilson's solution is his theory of gene-culture coevolution, which he had elaborated in the book of that title. He explains the problem in very simplistic terms: "We know that virtually all of human behavior is transmitted by culture. We also know that biology has an important effect on the origin of culture and its transmission. The question remaining is how biology and culture interact."[53]

Aye, and there's the rub. The full impact of Wilson's eccentric theories can only be gained from direct quotation:

> Culture is created by the communal mind, and each mind in turn is the product of the genetically structured human brain. Genes and culture are therefore inseverably linked. But the linkage is flexible, to a degree still mostly unmeasured. The linkage is also tortuous—genes prescribe epigenetic rules, which are the neural pathways and regularities in cognitive development by which the individual mind assembles itself. The mind grows from birth to death by absorbing parts of the existing culture available to it, with selections guided through epigenetic rules inherited by the individual brain. [54]

To my mind, this does not seem to have anything to do with Whewell's consilience of inductions or with the scientific method in general. The terminology is vague and evasive: "flexible," "tortuous," "the mind assembles itself." How does one leap from hundreds of billions of

neurons to coded external behavior? What of chance mutation and environmental factors? Wilson simply wills his consilience into being. Natural selection has added the parallel track, as he calls it, of cultural evolution to genetic evolution, *ipso facto*. It is interesting to note that Wilson abandons his awkward coinage of culturgen to signify the basic unit of culture as corresponding to the gene. He himself admits that the idea of "genes to culture," the bridge between science and the humanities, has an ethereal feel to it, and that one cannot properly speak of a gene that "prescribes" culture. He merely says that the web of causal events comprising gene-culture coevolution is more complicated, and he leaves it to the "unstoppable" neuroscientists to map neural activity patterns. From there the etiology of culture wends its way tortuously to learning and social behavior. Rather than speak of units of culture he speaks now of neurobiological traits that cause us to see the world in a particular way and to learn certain behaviors in preference to others.

At one point in the discussion Wilson explains one of the determining levels of biological organization known as universals of culture, among which he lists cleanliness, community organization, cooperative labor, etc., to a total of sixty-seven, as compiled by the American anthropologist George P. Murdock.[55] Wilson says that it is tempting to dismiss these traits as not truly diagnostic of human behavior, but inevitable in the evolution of any species that attains complex societies. To illustrate his point, Wilson conjures up an imaginary scene of an assembly of a super-termite species, to whom their leader might give the following "state-of-the-colony" speech:

> Ever since our ancestors, the macrotermitine termites, achieved ten-kilogram weight and large brains during their rapid evolution through the late Tertiary Period, and learned to write with pheromonal script [pheromones, you will

> remember, are the secretions used for communication, studied by Wilson], termite scholarship has elevated and refined ethical philosophy. It is now possible to express the imperatives of moral behavior with precision. These imperatives are self-evident and universal. They are the very essence of termitity. [sic!] They include the love of darkness and of the deep, saprophytic, basidiomycetic penetralia of the soil, the centrality of colony life amidst the richness of war and trade with other colonies, the sanctity of the physiological caste system; the evil of personal rights (the colony is ALL!) [Wilson's emphasis!]; our deep love for the royal siblings allowed to reproduce the joy of chemical song; the aesthetic pleasure and deep social satisfaction of eating feces from nestmates' anuses after the shedding of our skins; and the ecstasy of cannibalism and surrender of our own bodies when we are sick or injured [it is more blessed to be eaten than to eat].[56]

One can only surmise that these strange ruminations are the result of spending too much time with ants and termites. Yet Wilson had made a similar comparison of the conduct of men and termites in a strange epilogue to chapter five of ***Sociobiology*** entitled "Group Selection and Altruism:" "For the moment perhaps, it is enough to establish that a single strong thread does indeed run from the conduct of termite colonies and turkey brotherhoods to the social behavior of man."[57] Wilson, like many other evolutionary biologists, habitually uses metaphors and a bizarre anthropomorphism taken from human society to describe animal society since he makes no distinction between the two. In the passage just cited he states explicitly that if this underlying thread of Darwinian fitness can be studied more closely in sociobiology, human conduct will be better understood. Instead of the mock-

epic treatment in ***Consilience***, he uses an example from Hindu mythology (with no guidance for the unsuspecting reader.) It is taken from the ***Bhagavad-Gita***, the story of Arjuna faltering on the Fields of Righteousness, torn between his duties to self and his duties to the family or tribe. He expresses his quandary to Krishna, who acknowledges that the Rule is hard to attain for one who is uncontrolled, but it can be won by obedient spirits by following the proper way. Wilson's comment is that sociobiology combined with neurophysiology will transform the insights of ancient religions into a precise account of the evolutionary origin of ethics and explain the reasons for certain moral choices; Wilson adds, "whether such understanding will then produce the Rule remains to be seen."[58] For "Rule," read the religion of sociobiology, handmaid of scientific materialism.

When consilience is applied to the arts and their interpretation, the results are even more disastrous, as one might imagine. Wilson assures us that he does not wish to fashion some hybridization of scientific art or artistic science (we may be thankful for that), but he suggests that the knowledge of science and its <u>proprietary sense of the future</u> (I underline this sentiment, reminiscent of Snow) will reinvigorate its interpretation. Wilson even turns literary critic for a moment and attempts a clumsy exegesis of Milton's Garden of Eden. He rules out the notion that Milton's art could have come from God (as the poet thought); nor could it have been some unique spark since, for example, experiments using brain imaging have failed to distinguish singular neurobiological traits in musically gifted people. Wilson is confident that as the workings of the brain are charted, with the collaboration of scientists and scholars from the humanities, it is likely that artistic innovation will be found to be a concrete biological process based on nerve circuitry and neurotransmitter release: "it is not the outpouring of symbols by an all-purpose generator or any conjuration therein by ethereal

agents."[59] By God! If this doesn't sound like Paracelsus *redivivus*! Metaphors are defined as "the consequence of spreading activation of the brain during learning." Wilson's evolutionary conclusion is: "The arts are not solely shaped by errant genius out of historical circumstances and idiosyncratic personal experience. The roots of their inspiration date back in deep history to the genetic origins of the human brain, and are permanent."[60] Thus, the arts also occupy their place in the procrustean bed of gene-culture coevolution. Direct evidence for this is scarce, to be sure, but Wilson has no doubts that new discoveries will corroborate his theories.

In the realm of religion and ethics, Wilson stages a mock dialogue between a transcendentalist, as he labels one who thinks that moral guidelines exist outside the mind, and an empiricist, one who considers them contrivances of the mind. It is a very shallow discourse, in which the palm is implicitly awarded, naturally, to the empiricist. In Wilson's facile and fuzzy hypothesis, precepts and religious faith are entirely material products of the mind, generated by epigenetic rules, hereditary biases of mental development. He speaks of the blind faith of those who believe in revealed truths, and yet the reason in which he trusts is merely a by-product of a mindless process at one stage of its endless becoming. He thus undermines his own argument. In order to account in some way for religious behavior, he theorizes that it could have evolved by natural selection (as does everything else.) He even sees a parallel between submissive behavior in organized mammalian societies and human obeisance to religious authority. I think this would have mystified even Darwin himself.

In the last chapter of ***Consilience***, entitled "To What End," Wilson sums up his biological synthesis of all learning: "The central idea of the consilient world view is that all tangible phenomena, from the birth of the stars to the workings of social institutions, are based on material

processes that are ultimately reducible, however long and tortuous the sequences, to the laws of physics."[61] It is odd that Wilson does not take into account that the certainties of Newtonian physics have now evolved into the unpredictabilities of quantum theory, the indeterminacy principle of Heisenberg, and theories of chaos. He continues to advocate his program of biologizing all branches of knowledge, reducing everything to a cause and effect method of investigation. This radical, triumphalist, hubristic exaltation of scientific materialism is his ludicrous proposal to solve the problem of the two cultures.

On the contrary, Wilson succeeds in putting up impenetrable barriers between the various approaches to learning, as the initial vehement reaction to his brand of sociobiology demonstrated. He brooks no opposition in his apotheosis of scientism. Before coming upon his camouflage of consilience, Wilson had said boldly in ***Sociobiology***: "It may not be too much to say that sociology and the other social sciences, as well as the humanities, are the *last branches in biology* [emphasis added] waiting to be included in the Modern Synthesis."[62] There it is: above all else his aspiration is synthesis, that is, reductionism. "The world henceforth will be run by synthesizers, people able to put together the right information at the right time."[63]

What is really dismaying about ***Sociobiology*** is its lack of scientific rigor. First and foremost Wilson seems to be unaware of the problem of circularity in his grand scheme. There is no reason to believe that the neural machinery of the brain, as he defines mind, *necessarily* enables one to reach true conclusions about the real world. He merely assumes the existence of the real, orderly world and the fact that evolution has so formed the brain that we can use it to investigate that world. Wilson is fine when he is speaking of ants, and the material world in general, but when he tries to explain man and society he is on very

uncertain ground. With the most flimsy of arguments he connects individual cognition with diverse patterns of cultural behavior. He uses facile slogans like "genes hold culture on a leash."[64] The problem of free will, disputed for centuries by philosophers and theologians, is dismissed as an illusion: "Confidence in free will is biologically adaptive. Without it the mind, imprisoned by fatalism, would slow and deteriorate. Thus in organismic time and space, in every operational sense that applies to the knowable self, the mind does have free will."[65]

What unfathomable profundities! In his myriad lucubrations Wilson also disregards the naturalistic fallacy, formulated by the Scottish philosopher, David Hume, that what biologically "is" is equivalent to what ethically "ought" to be. Normative conclusions are not deducible from factual premises. As he comes towards the end of his discourse, Wilson lets fall one of those ominous statements that some scientists are wont to make. Commenting on the Human Genome Project, he states: "It is entirely possible that within fifty years we will understand in considerable detail not only our own heredity, but also a great deal about the way our genes interact with the environment to produce a human being. We can then *tinker* [emphasis added] with the products at any level: change heredity, or change them permanently by mutating the genes and chromosomes."[66]

From these ill-omened musings it is an easy step to what I should not hesitate to call the lunatic fringe. When the idea of the cultural evolution of the species reaches the minds and laboratories of the technologists, the distinctions between science and science fiction are all but obliterated. A flagrant example of this is the 1999 book of Ray Kurzweil, an adept in artificial intelligence formerly at MIT, but now a free-lance inventor. The book is entitled ***The Age of Spiritual Machines*** with the subtitle ***When Computers Exceed Human Intelligence.*** The time frame referred to in the subtitle will be about thirty years in

Kurzweil's reckoning, while the complete transformation of the species will be accomplished within a hundred years.

By that time, through what Kurzweil calls the "law of accelerating returns" the computer will not only have surpassed the processing capacity of the human brain, but will have achieved consciousness. I shall quote his contorted reasoning:

> The machines will convince us that they are conscious, that they have their own agenda worthy of our respect. We will come to believe that they are conscious much as we believe that of each other. More so than with our animal friends we will empathize with their professed feelings because their minds will be based on the design of human thinking. They will embody human qualities and will claim to be human and we will believe them.[67]

To put human existence into the proper cosmic perspective, Kurzweil reminds us from the start of the sobering fact that about ninety-nine percent of all species that have ever inhabited the earth are now extinct. So *homo sapiens*'s day in the sun as the leading intellectual force on the planet is nearly over, according to Kurzweil. The lights will go out sometime around the middle of the twenty-first century. But humanity should not be dismayed, for that will be the dawning of the age of spiritual machines. Our puny carbon-based brain will be replaced by its own inventions. Natural implants will be introduced into the brain by billions of nanobots (microscopic, self-replicating robots) that will interact with the neurons of the brain. They will be able to scan the entire brain and nervous system and the contents of the brain will then be "insubstantiated" (is Kurzweil consciously mimicking the doctrine of transubstantiation?) into a huge database. This will be accomplished by an elegant, non-invasive technology—none of the crude

experiments of Dr. Frankenstein. The resulting wireless network can then interface with the web for further enhancement. Humans will co-evolve (to use Wilson's term) with machines until a new human-machine hybrid is formed. "We will be *software not hardware*" [Kurzweil's italics].[68] We will increase our longevity since we will be able to rebuild our bodies, cell by cell, with different and better materials, using "nanotechnology." We may even become immortal since we will keep copies of our programs and databases in storage and thus can be reconstructed at will. Kurzweil has a glossary at the end of his book to explain some of his more unfamiliar concepts. For example, MOSH is an acronym for Mostly Original Substrate Human, referring to those unfortunate individual beings who are not endowed with neural implants and will therefore be reduced to the condition of drones in the new order of things.

Is this not the stuff of madness? For me, it is a telling illustration of the title Francisco Jose de Goya (1746-1828) gave to one of the hallucinatory paintings in his series ***Los Caprichos***: "*El sueño de la razón produce monstruos*" (The dream of reason produces monsters.) Yet Kurzweil propounds all of this as if it were factual, even inevitable. He endows his artificial intelligences with human qualities: they will go to church for prayer and meditation. After all, neuroscientists at the University of San Diego have individuated the "God module" in the brain, a tiny locus of nerve cells in the frontal lobe which is activated during religious experience. (This was discovered, by the way, in an epileptic, a curious coincidence, since the ancient Greeks called epilepsy the sacred disease.) Other advantages will accrue to this nanobot-infused super being. Kurzweil stresses that virtual sex will soon be a "viable competitor to the real thing," affording "sensations that are more intense and pleasurable than conventional sex." He hawks these prurient delights in appropriately vulgar terms: "Hug your favorite movie

starlet at the Columbia Pictures site. Get a little more intimate at the Penthouse or Playgirl site. Of course there may be a small charge."[69] The worst thing about all this is that Kurzweil is deadly serious, and he is taken seriously by his former associates in the Program of Artificial Intelligence at MIT.[70] He does not think that he is writing science fiction, nor would he conceive that others might think his a parody of future scenarios. What is especially disturbing about Kurzweil's conception is that he calls these machines "spiritual," *i.e.*, conscious. In his review in the ***New York Review of Books*** the philosopher John Searle diagnoses the root fallacy very clearly: "He confuses the computer simulation of a phenomenon with a duplication or re-creation of that phenomenon."[71] The computer can only simulate the neurobiological processes in the brain that cause consciousness. At the beginning of his book Kurzweil described the insignificance of man's position in the world, a mere speck of dust; Blaise Pascal (1623-1662) had called man a reed, but a thinking reed ("*un roseau pensant*"), which a machine is not.

The dream of improving the human species—to achieve immortality—is an ancient one but it seems to be more prevalent than ever in the present day, nurtured by the advancements of science and technology. Julian Huxley, the half-brother of Aldous, vaunted already in the '30s that if given a free hand, science could control the evolution of the species. A friend of Sir Charles Snow, the biologist John Desmond Bernal, wrote a book, ***The World, the Flesh, and the Devil: An Enquiry into the Future of the Three Enemies of the Rational Soul*** (Bloom, 1969), once again not thought to be science fantasy but a scientific prediction of the future. Although written in 1929 it was re-issued in 1969, giving greater currency to his prophetic vision. According to Bernal the three entities of his title constitute the three enemies of humanity. Physics will tame the massive intelligible forces of nature, biology will correct the shortcomings of the human body, and

psychology will eliminate man's desires and fears. His solution for the problems of our weak flesh is a mechanized body, not as sophisticated as Kurzweil's, but similar in nature. The framework of the body will be of some very rigid material, "probably not metal but one of the new fibrous materials." The brain would exist in a cylinder, immersed in a liquid of the nature of cerebro-spinal fluid and kept supplied with fresh oxygenated blood. It would be connected to artificial organs, which might in large part be made from living organs except that they would be self-repairing. There would also be locomotor apparatus designed for slow movement, rapid transit, and flight. These will be the new super-beings who will go to dwell on other planets and leave the old race on earth to become a zoo. Let us listen to Bernal's rationalization:

> The new man must appear to those who have not contemplated him before as a strange, monstrous and inhuman creature, but he is only the logical outcome of the type of humanity that exists at present. It may be argued that tampering with bodily mechanism is as unnecessary as it is difficult, that all the increase of control needed may be obtained by extremely responsive mechanisms. outside the unaltered human body. But though it is possible that in the early stages a surgically transformed man would actually be at a disadvantage in capacity of performance to a normal, healthy man, he would still be better off than a dead man. . . . Normal man is an evolutionary dead end; mechanical man, apparently a break in organic evolution, is actually more in the true tradition of a further evolution.[72]

Such are the excesses to which the scientific mentality can go. It is obvious that the relentless quest for scientific truth must be tempered and balanced by

reflections on the human condition that can be found in the study of philosophy, religion, literature, history—in a word—the humanities, those studies concerned with human complexity, with the nonlinear, the non-material. Scientists like Wilson and Richard Dawkins (author of ***The Selfish Gene*** and ***The Unweaving of the Rainbow***) have reduced humanity to an epiphenomenon of competitive behavior of the genes. In their view, man may still be a rational animal but he is more animal than rational. With such bleak prospects for the species certain inventive individuals, capitalizing on the theories of scientists, have decided to abdicate our human origins altogether and intervene in the process of evolution. They aspire to be robots or immortal humanoids with wires in their heads. There was a period in recent years when people willed their bodies to be mummified by the modern techniques of cryonics so that they might be revived when technology will have discovered the secret of prolonging their lives. But what kind of life will it be?

Neither blind acquiescence to the schemes of technology nor a specious unilateral consilience is a solution to the cultural divide inherent in modern civilization and education. What is needed is dialogue, mutual respect, a sharing of views, and cooperation. A good example of this is the Gifford Lectures on natural theology, established by Alan Lord Gifford at Edinburgh in 1885, "to attain knowledge of the All, of the First and Only Cause." Over the years many of these lectures, given alternately at Edinburgh and Aberdeen, have dealt with the history and philosophy of science. In a recent series of lectures, 1990-91, published as ***Religion in an Age of Science*** (San Francisco, 1991) and ***Ethics in an Age of Technology*** (San Francisco, 1993), Ian Barbour has emerged as one of the leading proponents of the dialogue between science and religion. He gave impetus to the current dialogue in a book entitled ***Issues in Science and Religion*** (San Francisco, 1966). Since then he has written

about a dozen books on the subject and has been joined by other writers such as John Polkinghorne, a Cambridge physicist who became an Anglican priest, and Arthur Peacocke, also a scientist and theologian. Many centers for the study of religion and science have sprung up throughout the United States, from Georgetown to Berkeley. A spate of books continues to appear, and there have been several national conferences on the subject in the last few years. In the spring of 1999, for example, there was a three-day conference held in the National Museum of Natural History in Washington on cosmic questions, in which John Polkinghorne debated scientific issues with physicist Steven Weinberg, a Nobel Prize winner. In his book on the origins of the universe, ***The First Three Minutes*** (New York, 1977), Weinberg enunciated this pessimistic view: "The more the universe seems comprehensible, the more it also seems pointless."[73] In contrast, Polkinghorne would hold that the human mind in its ability to penetrate some of the mysteries of the universe through mathematics gives indication that human consciousness is somehow harmonious with the mind of God. Rather than blind chance, Polkinghorne favors cosmological theories that maintain the traditional argument from design, that organic life could only emerge in the present universe with its physical laws and constants. Even the slightest change would have resulted in an uninhabitable universe. The theory of intelligent design thus functions as a *via media* between Darwinism and creationism.

A great number of scientists would agree that scientific accounts do not succeed in making sense of cosmic history and that there should be no hostility between the disciplines of religion and science. A brochure of the Association for the Advancement of Science puts it this way: "Science is about causes, religion about meaning. Science deals with how things happen in nature, religion with why there is anything rather than

nothing." There is no reason for antagonism. Both the agnostic scientist and the believer have to have faith in a certain given, whether it be God or the laws of physics. The Christian approach was succinctly expressed long ago by St. Anselm (archbishop of Canterbury 1092-1109): *fides quaerens intellectum* (faith seeking understanding). There must be humility on both sides and each side must respect the integrity of the other. The two can be partners in a common quest for understanding, or at the very least, as Stephen Jay Gould advocates in his recent ***Rocks of Ages*** (New York, 2000), they can maintain a policy of respectful non-interference.

A fertile common ground for mutual understanding between the two cultures is the history and philosophy of science. The first to initiate this study formally was George Sarton (1884-1956), a Belgian who taught at Harvard and wrote voluminous works on the history of science, which he had projected in nine volumes, but of which he finished only three huge tomes replete with rich bibliographies. In order to write the history of science from the ninth to the eleventh centuries, he set himself to study Arabic, traveling throughout North Africa and the Near East. He had a truly humanistic vision of his subject, criticizing both the aloofness of the old humanists and the isolation and narrow-mindedness of some scientists.

Another towering figure in the philosophy of science is the great philosopher and mathematician, Alfred North Whitehead. He was a man of many parts, one who could collaborate with Bertrand Russell in writing ***Principia Mathematica*** or deliver a series of popular lectures, "Science and the Modern World" (1925) while lecturing at Harvard, or write a seminal work in metaphysics, ***Process and Reality*** (1929). He emphasizes that although scientific observation is guided by rigorously formulated theories, it also involves creative imagination that points the way to new factors. In comparing science

to philosophy, Whitehead contends that natural science is incapable of providing an adequate understanding of the complexities of the universe: "it is the task of philosophy to penetrate beyond the more obvious accidents to those principles of existence which are presupposed in dim consciousness."[74] Whitehead opposed what he termed the fallacy of bifurcation, the tendency to break up the natural unity of thought. He viewed reality as a logical system of ideas from physics and mathematics to logic, biology, religion and art.

In more recent times Thomas Kuhn of the University of Chicago, in his important book ***The Structure of the Scientific Revolution*** (Chicago, 1962), pointed out that the progress of science is not a steady accumulation of knowledge but undergoes sudden alterations called paradigm shifts which involve a fundamental change of perspective. External factors, such as political, cultural and economic forces, are now taken into consideration. Indeed, the history of science is one of the most interesting aspects of science and serves as a link with the humanistic disciplines.

Another approach to the scientific method is represented by Michael Polanyi, a physicist turned philosopher who emphasizes the role of intuition and imagination in the nature and procedure of science. Science is concerned with the impersonal physical world but its pursuit is an activity of persons. According to his theories, human reason never acts outside a framework of basic beliefs that are already present. There exists a tacit knowledge, a non-formal relation between mind and reality. This is really not very different from Shelley's statement that "poetry comprehends all science." (Though primarily a poet, Shelley took great pleasure in his divagations into scientific pursuits.) As Whitehead remarked in one of his lectures, it is essential to keep in mind that science and poetry have the same root in human nature.

In the ferment of scientific speculation that took place in the seventeenth century, which Whitehead called the first Physical Synthesis, the present dichotomy of the "two cultures" did not exist. Galileo Galilei (1564-1642) is a pre-eminent example in this regard. In addition to his astonishing scientific acumen he was able to describe his experiments in a masterful Italian prose or in transparent Latin. He was learned in classical literature; he studied logic with a monk at Vallombrosa; he gave lectures to the Florentine Academy on the topography of Dante's ***Inferno***, using Archimedes's theory of conic sections. We have his literary commentary in the margins of his copy of Ariosto; he could draw, paint, and play the lute; he illustrated the spots he observed on the moon with maps and his own watercolors. He could also be a shrewd businessman. When he heard the news of the Flemish invention of the telescope, then known as the spy-glass, he stepped up the magnification to eight or ten and sold it to the Venetians so that they could spot ships far off at sea. His true innovation was to use it as an instrument of research, training it on the heavens. He then published his observations in 1610, the splendid ***Sidereus nuntius*** (***The Starry Messenger***), and told the world of his discovery of four new planets, which in reality, were the satellites of Jupiter. With all his immense talent, he still acknowledged at the beginning of that work the illumination of divine grace (*divina prius illuminante gratia*). Here was the complete scientist, skilled in observation, eager to decipher the mathematical language of nature's great book, and able to communicate his findings in a delightful style of writing.

There is another common ground where the sciences and the traditional humanities can meet, and that is music. From the time of the Greeks, music has always been associated with mathematics. Boethius recognized not only a *musica mundana*, music of the spheres, but a *musica humana*, which was also inaudible, but represented

the harmony of mind and body. Kepler was convinced that the motion of the planets obeyed musical rules expressible in mathematics. A former colleague of mine at the University of Windsor, Ontario, Geza Szamosi, both a nuclear physicist and a musician, wrote a fine book on the invention of time and space, ***The Twin Dimensions*** (New York, 1986), in which he showed how the perception of motion in music was very important to the concept of time, referring to the musical theories of Vincenzo Galilei, Galileo's father, as put into practice by Claudio Monteverdi (Italian composer and "father of opera," 1567-1643). Physicists, in particular, have a fondness and aptitude for music. As with the ancient Greeks, perhaps, the contrapuntal structure of music recalls to them the dynamic structures of the universe. Einstein, of course, was a gifted violinist and played chamber music with such pre-eminent musicians as twentieth-century pianist Arthur Schnabel (1882-1951). Whether it be the symmetry of a Mozart sonata, the deep meditation of a Beethoven string quartet, the invigorating dissonances of Stravinsky, or the rhythmic vitality of *salsa*, music speaks to us all.

It would certainly be asking too much that modern scientists should automatically be able to duplicate the genius of a Galileo or an Isaac Newton, but there are some scientists today versed in literature and the arts who make use of this knowledge in their scientific writings. A good example is the late Steven Jay Gould, paleontologist at Harvard University, who gave a popular series of courses there in the "Basics of Evolution." Together with Richard Lewontin he presented a paper to the Royal Society in England on his concept of evolution that made ingenious use of a paradigm from architecture.[75] In visiting Venice he observed that the dome of the cathedral of San Marco rests on four rounded arches that meet at right angles. As a consequence, there are four tapering triangular spaces where any two arches meet at right angles. These are called spandrels, or pendentives. At San Marco's they are

decorated with frescoes depicting scenes that are iconographically (not physically) linked with the dome. He compares this to evolutionary features that do not arise linearly from adaptation. Adaptive changes "throw off" a series of structural by-products like the spandrels. So with the human brain, which was enlarged by natural selection for its adaptation to the African savannas but has taken on so many other functions in its evolution. The paradigm was used to refute the tenets of strict Darwinian adaptationists. In another Darwinian vein, the contemporary philosopher of science Michael Ruse, from Guelph University in Canada, has written an interesting book for general audiences entitled ***Can You Be a Darwinian and a Christian?*** (Cambridge, 2001), in which, though an agnostic himself, he established bridges between religious beliefs and science.[76]

At the approach of the millennium, amidst the panic of the Y2K crisis and millenary hopes and fears, some of us were reminded of what occurred at the dawning of the first millennium. A pivotal figure at that moment was Gerbert d'Aurillac, the first French successor to Saint Peter, who took the name of Sylvester II (pope 999-1003). He was a very learned man in both the arts and the sciences, having imbibed much new learning from a stay in Spain, where he read various Arabic scientific treatises that had been translated into Latin. He is credited with having introduced Hindu-Arabic numerals into the West. Luckily he did. It would have taken some ingenuity to change the date from DCCCCXCIX to M in their computations. Gerbert also had had constructed for himself an elaborate abacus with a thousand figures made of horn, with which he was capable of rapidly performing complicated mathematical operations; it was a supercomputer of the day.

If we are to believe the prophecies of experts like Kurzweil, the present computational machine is destined to take over (these experts use the word "enhance") our

lives much more radically than it already has. Dissatisfied with man's fragility, these modern visionaries would redesign the human species after their own image. They have invented the cyborg (itself an ugly lexical concoction from the Greek roots *kybernetes*, "steersman," and *organon*, "tool"), a hybrid man-machine, implanted with bioelectronic devices. Evolutionary biologists speak of "the survival of human genes in the form of a common pool over generations."[77] The individual human being is reduced to the status of an epiphenomenon of its genes, a "genetic survival machine" to use Richard Dawkins's phrase, programmed to preserve the selfish genes, as in the title of his book. Consequently morality has no other demonstrable function than to keep genetic material intact.

Yet, somehow, mind and reason are perversely maladaptive to the schemes imposed by neo-Darwinian theories of natural selection. In the gradual decoding of the complete sequence of the human genome, some scientists believe that they have found the sole determinant of our human individuality, the last word about human nature. Our very humanity is at stake. How far we have strayed from the ideals expressed at the beginning of the modern era by Pico della Mirandola in his oration ***On the Dignity of Man***. Quoting ancient classical sources, he exclaims, "*Magnum miraculum est homo*." (A great miracle is man.) This sentiment finds echo in Hamlet's speech: "What [a] piece of work is a man, how noble in reason, how infinite in faculties . . . in apprehension, how like a god!" (II, ii, 303-307).

It seems that we have arrived at that age Leavis spoke of in his Richmond lecture, when there are "changes so rapid and of such a kind . . . that mankind will need to be in full intelligent possession of its full humanity."[78] We have need of a *consonance*, not a *consilience*, of women and men of all disciplines to avert some of the indignities to humanity and to nature that are being perpetrated by

political and commercial interests. Humanists must be aware of what is happening in the scientific world and scientists must not lose sight of their humanity. C. H. Waddington, who enthusiastically endorsed Wilson's ***Sociobiology*** in the pages of the ***New York Review of Books***, summed up the triumph of science in the last pages of his ***The Scientific Attitude*** as follows: "Science by itself is able to provide mankind with a way of life which is, firstly, self-consistent and harmonious, and secondly, free for the exercise of that objective reason on which our material progress depends. So far as I can see, the scientific attitude of mind is, at the present day, adequate in both respects."[79] A bold, arrogant, and narrowly limited statement to which some scientists still implicitly subscribe. Pascal's more humble dictum rings truer: "*Le coeur a des raisons que la raison ne connaît point.*" (The heart has reasons which reason knows nothing of.)

As the future of humanity and of the planet becomes ever more precarious, it is more and more imperative that we rise above our disciplinary differences and communicate with one another on equal terms in the communality of the *one* culture.

ENDNOTES

1 Quotations are taken from an expanded version of the lecture, C.P. Snow, *The Two Cultures and a Second Look* (Cambridge, 1964), p. 1.[Cited subsequently as *The Two Cultures.*]
2 Ibid., p. 2.
3 Ibid., p. 4.
4 Ibid., p. 44.
5 Ibid., p. 48.
6 Ibid.
7 *New Statesman*, Oct. 6, 1956, p. 431.
8 *The Two Cultures*, p. 10.
9 Ibid., p. 11.
10 Ibid., p. 101, n. 6.
11 Ibid., p. 14.
12 This argument is well made from the scientist's point of view by Michael Yudkin, a research biochemist, in a critique of Snow's lecture published with F.R. Leavis' Richmond lecture. F.R. Leavis, *The Two Cultures? The Significance of C.P. Snow* (New York, 1963), pp. 54-57.
13 *The Two Cultures,* p. 25.
14 Ibid.
15 Ibid.
16 Ibid., p. 50
17 F.R. Leavis, *Two Cultures? The Significance of C.P. Snow* (New York, 1963), p. 27.
18 Ibid., p. 32.
19 Ibid., p. 45.
20 Ibid., p. 46.
21 *The Two Cultures,* p. 100.
22 Aldous Huxley, *Literature and Science* (New York, 1963).
23 Stéphane Mallarmé, "*Le Tombeau de Edgar Allan Poe,*" *Poésies*, ed. Bertrand Marchand (Paris, 1992), p. 60.
24 T.H. Huxley, *Science and Education* (New York, 1902), p. 80.
25 Ibid., p. 90.
26 *Complete Prose Works of Matthew Arnold*, vol. X (Ann Arbor, 1986), p. 61.
27 Matthew Arnold, *Essays in Criticism* (Chicago, 1968), p. 29.
28 *Complete Prose Works of Matthew Arnold*, vol. IV, p. 60.
29 Ibid., p. 73.
30 He gave the lecture twenty-nine times. In a letter to his sister Frances of 26 November 1883, he writes that the audiences were wildly enthusiastic, especially in New England. *Selected Letters of Matthew Arnold* ed. Clinton McChann (Ann Arbor, 1993), p. 267.
31 William Whewell, *The Philosophy of the Inductive Sciences* vol. II (London, 1840), pp. 70-71.
32 Edward O. Wilson, *Consilience* (New York, 1998), p. 11.
33 Ibid., p. 12.

34 Wilson made important finds early in his career in the study of pheromones, chemical substances, usually glandular secretions, that are used for communication within a species: "A chemical release of alarm and digging behavior in the ant Pogonomyrmex bodius," *Psyche* 65 (1958) 41-51.

35 E. O. Wilson, *The Insect Societies* (Cambridge, Mass., 1971), p. 460.

36 Boyce Rensberger, "Sociobiology: Updating Darwin on Behavior" *New York Times*, 28 May 1975, p. 1.

37 E.O. Wilson, *Sociobiology* (Cambridge, Mass., 1975), p. 4. The phraseology recurs in *On Human Nature* (Cambridge, Mass., 1978), p. 16.

38 Ibid., p. 547.

39 Herbert Spencer, *The Study of Sociology* (New York, 1874), p. 48.

40 *Sociobiology*, p. 22.

41 Ibid., p. 23.

42 Elizabeth Allen et al., "Against Sociobiology," letter to the *New York Review of Books* 13 November 1975, pp. 43-44. This was in answer to the encomiastic review of Wilson's book by C.H. Waddington, elder statesman of biology, "Mindless Societies," *New York Review of Books*, August 7, 1975, pp. 30-32. In the concluding paragraph of his famous book, *The Scientific Attitude* (Middlesex, 1948), p. 172, Waddington had referred contemptuously to the "harlot Humanities." p. 44.

43 *Sociobiology*, p. 575.

44 Ibid.

45 *Sociobiology at Century's End* (Cambridge, Mass., 2000), pp. vii and viii.

46 E. O. Wilson, *On Human Nature* (Cambridge, Mass., 1978), p. 2.

47 Ibid., p. 208.

48 Charles J. Lumsden and E. O. Wilson, *Genes, Mind and Culture: The Coevolutionary Process* (Cambridge, Mass., 1981), p. 7.

49 Ibid., p. 344.

50 Charles J. Lumsden and Edward O. Wilson, *Promethean Fire* (Cambridge, Mass., 1983), p. 19.

51 Ibid.

52 *Consilience*, p. 8.

53 Ibid., p. 126.

54 Ibid., p. 127.

55 George P. Murdock, *Culture and Society* (Pittsburgh, 1965), pp. 91-95.

56 *Consilience*, p. 148.

57 *Sociobiology*, p. 129.

58 Ibid.

59 *Consilience*, p. 216.

60 Ibid., p. 218.

61 Ibid., p. 266.

62 *Sociobiology*, p. 4.

63 *Consilience*, p. 269.

64 *On Human Nature*, p. 176.

65 *Consilience*, p. 120.
66 Ibid., p. 474.
67 Ray Kurzweil, *The Age of Spiritual Machines* (New York, 1999), p. 28.
68 Ibid., p. 129.
69 Ibid., p. 144.
70 Research financed by commercial enterprises are going forward in this sector of technology. There is a Center for Nanoscale Science and Technology at Rice University headed by Nobel Prize winner, Richard Smalley.
71 John Searle, "I Married a Computer," *New York Review of Books* 8 April 1999, p. 37.
72 John Desmond Bernal, *The World the Flesh and the Devil* (Bloomington, 1969) p. 42.
73 Steven Weinberg, *The First Three Minutes* (New York, 1977), p. 149.
74 From the essay "Science in General Education" in Alfred North Whitehead, *The Interpretation of Science. Selected Essays* ed. A.H. Johnson (Indianapolis, 1961), p. 167.
75 Richard Lewontin and Steven Jay Gould, "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme," *Proceedings of the Royal Society*, London (1979) 581-598.
76 Ruse has also written many other books in which he makes scientific knowledge accessible to the reader.
77 *On Human Nature*, p. 196.
78 Leavis, *Two Cultures*, p. 46.
79 Waddington, *The Scientific Attitude*, p. 170.