Ten Cheers for Interdisciplinarity: The Case for Interdisciplinary Knowledge and Research

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The frequently-encountered wholesale dismissal of either interdisciplinary knowledge or research reflects a profound misunderstanding of their vital contributions to scholarship, society, and individuals. This article presents the only self-contained, comprehensive defense of interdisciplinary knowledge and research, arguing that they are important because: 1. Creativity often requires interdisciplinary knowledge. 2. Immigrants often make important contributions to their new field. 3. Disciplinarians often commit errors which can be best detected by people familiar with two or more disciplines. 4. Some worthwhile topics of research fall in the interstices among the traditional disciplines. 5. Many intellectual, social, and practical problems require interdisciplinary approaches. 6. Interdisciplinary knowledge and research serve to remind us of the unity-of-knowledge ideal. 7. Interdisciplinarians enjoy greater flexibility in their research. 8. More so than narrow disciplinarians, interdisciplinarians often treat themselves to the intellectual equivalent of traveling in new lands. 9. Interdisciplinarians may help breach communication gaps in the modern academy, thereby helping to mobilize its enormous intellectual resources in the cause of greater social rationality and justice. 10. By bridging fragmented disciplines, interdisciplinarians might play a role in the defense of academic freedom. The case against interdisciplinary knowledge and research is made up of many intrinsic drawbacks and practical barriers. Taken together, these rewards, drawbacks, and barriers suggest a mild shift in the contemporary world of learning towards interdisciplinary knowledge and research.

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"Your planet is very beautiful," [said the little prince]. "Has it any oceans?"
"I couldn't tell you," said the geographer. . . .
"But you are a geographer!"
"Exactly," the geographer said. "But I am not an explorer. I haven't a single explorer on my planet. It is not the geographer who goes out to count the towns, the rivers, the mountains, the seas, the oceans, and the deserts. The geographer is much too important to go loafing about. He does not leave his desk." Antoine de Saint Exupery (*The Little Prince*, pp. 63–64)

INTRODUCTION

Long ago, C. P. Snow (1964a) observed that the intellectual life of the West was being increasingly split, with literary intellectuals at one pole and physical scientists at another. As a consequence, the West lost even a pretense of common culture. This cultural divide, in Snow's view, entailed serious consequences for our creative, intellectual, and everyday life.

By now, most of us no longer think it possible to become a Renaissance Scholar a la Leonardo da Vinci. Gradually during the nineteenth century, the ideal of the unity of knowledge—that a genuine scholar ought to be familiar with the sum total of humanity's intellectual and artistic output—gave way to specialization. Humanity's ever-growing store of knowledge, and the fact that each person is bestowed with a unique set of aptitudes, left most scholars and artists stranded in ever-shrinking islands of competence (Cummings, 1989):

> No people in our own time could rationally proclaim that they knew everything about everything, or even everything about their own fields.... Instead of being challenged by the slowly emerging knowledge of the Renaissance, we are now being deluged by torrents of new information almost daily. In self-defense, to avoid drowning and attain some kind of footing, we seek to come ashore on ever-smaller islands of learning and inquiry.... To look beyond ... is to be overwhelmed by the ocean's magnitude: better to remain ignorant of all but our own tiny province.... The result in our own time is not just Snow's "two cultures" but in fact a multitude of cultures, each staking out a territory for itself, each refusing to talk to the other, and each resisting all attempted incursions from surrounding "enemies" (Miles, 1989, pp. 15–16).

Others take a more sanguine view of the contemporary world of learning:

> It has become too easy to criticize esoteric research as narrow, detached, and trivial. Such criticism lacks an appreciation for the elegant way in which fields of study merge.... Some links facilitate integration and thereby prevent specialization from becoming narrow-mindedness.... We need to reconceptualize our model of disciplinary growth and specialization, adopting a more organic model that accounts for the intricate links among the many specializations. Our current mechanistic model divides disciplines into numerous blocks of specializations; it is inaccurate ... and misleading (Ruscio, 1986, pp. 43–44).

Regardless of one's views about the extent of compartmentalization in the modern research and creative enterprises, it is clear that specialization in one form or another is here to stay. The question that keeps rearing its head concerns the future and legitimacy of interdisciplinarity. Some people feel that any attempt at interdisciplinarity smacks of dilettantism, perhaps even charlatanism. This article will show that this view entails a profound misunderstanding of the intellectual, social, and personal rewards of interdisciplinary knowledge and research.

WHAT IS INTERDISCIPLINARITY?

Although many have tried to define interdisciplinarity (Berger, 1972; Kockelmans, 1979; Mayville, 1978; Stember, 1991), it still seems "to defy definition" (Klein, 1990). The most widely cited attempts break down interdisciplinarity into components such as multidisciplinarity, pluridisciplinarity, crossdisciplinarity, and transdisciplinarity. Because these subdivisions throw little light on the theory and practice of interdisciplinarity, elsewhere (Nissani, 1995a) I have proposed their replacement with a more appropriate definition. To begin with, a *discipline* can be conveniently defined as any comparatively self-contained and isolated domain of human experience which possesses its own community of experts. *Interdisciplinarity* is best seen as bringing together distinctive components of two or more disciplines. In academic discourse, interdisciplinarity typically applies to four realms: knowledge, research, education, and theory. Interdisciplinary knowledge involves familiarity with components of two or more disciplines. Interdisciplinary research combines components of two or more disciplines in the search or creation of new knowledge, operations, or artistic expressions. Interdisciplinary education merges components of two or more disciplines in a single program of instruction. Interdisciplinary theory takes interdisciplinary knowledge, research, or education as its main objects of study.

This article is largely concerned with the defense of interdisciplinary knowledge and research in typical academic settings. Although almost identical arguments could be used in defense of interdisciplinary knowledge and creativity in the arts, such a defense will not be undertaken here. Also, this essay is largely confined to the knowledge and research aspects of academic interdisciplinarity, leaving for another occasion a discussion of the similar, but more complex and ambivalent, case of education. Likewise, this essay only offers reflections in—but not about—interdisciplinary theory.

REWARDS OF INTERDISCIPLINARY KNOWLEDGE AND RESEARCH

When pressed to justify interdisciplinary knowledge and research, theorists typically come up with two or three arguments. No single treatise known to me makes a comprehensive case for interdisciplinarity. This section tries to fill that gap. In doing so, it relies on the reflections of interdisciplinary theorists, on the reflections of others, and (especially in the choice of illustrations) on my own experiences in a variety of fields.

As will be seen, the specific rewards listed below fall within three overlapping categories: (1) growth of knowledge, (2) other social benefits, and (3) personal rewards.

Creative Breakthroughs

The very act of creation often involves the bringing together of previously unrelated ideas (Koestler, 1964). Highly creative artists and thinkers form unconventional but fruitful permutations of disparate ideas (Simonton, 1988). The combined aspects may be drawn from a single discipline, as in Torricelli's sea of air hypothesis, or from everyday experiences and a single discipline, as in Archimedes' celebrated "eureka" case. The act of creation may also arise from the permutation of ideas from two or more disciplines. Thomas Kuhn, for instance, noticed the striking similarity between a gestalt switch (psychology) and a paradigmatic shift (history of science).

Most observers of the creative moment concur: "The clashing point of two subjects, two disciplines, two cultures—of two galaxies, so far as that goes—ought to produce creative chances. In the history of mental activity that has been where some of the break-throughs came" (Snow, 1964a, p. 16). "Intellectual cross-pressures generated by an interdisciplinary outlook liberate a person's thinking from the limiting assumptions of his own professional group, and stimulate fresh vision" (Milgram, 1969, p. 103). "The periods of greatest excitement and of expanded vision in our joint work as social psychologists have been during interdisciplinary efforts" (Sherif, 1979; see also Becher, 1989; Bechtel, 1986; Florman, 1989; Gaff, 1989; Miles, 1989; Moffat, 1993; Ruscio, 1986). C. Wright Mills (1959, pp. 211–212) puts it well:

> The sociological imagination ... in considerable part consists of the capacity to shift from one perspective to another, and in the process to build up an adequate view of a total society and of its components. It is this imagination, of course, that sets off the social scientist from the mere technician. Adequate technicians can be trained in a few years. The sociological imagination can also be cultivated; certainly it seldom occurs without a great deal of routine work. Yet there is an unexpected quality about it, perhaps because its essence is the combination of ideas that no one expected were combinable—say, a mess of ideas from German philosophy and British economics. There is a playfulness of mind back of such combining as well as a truly fierce drive to make sense of the world, which the technician as such usually lacks. Perhaps he is too well trained, too precisely trained. Since one can be *trained* only in what is already known, training sometimes incapacitates one from learning new ways; it makes one rebel against what is bound to be at first loose and even sloppy.

Thus, if chance favors the prepared mind, and if preparation often involves grounding in two or more disciplines, then those who wish to speed up the growth of knowledge should promote, or at least tolerate, interdisciplinary knowledge and research.

Outsider's Perspective

According to some observers (Becher, 1989, p. 118), "career mobility ... is among the most potent sources of innovation and development within a discipline." For instance, seventeen out of forty-one scientists in the phage group (which played a decisive role in mid-century biology) were physicists or chemists by training. Heinrich Schwabe was a pharmacist, James Joule a brewer, Paul Gauguin a stockbroker. Thomas Hunt Morgan was trained as an embryologist, A. E. Housman as a classicist,

Somerset Maugham as a physician. There is a pattern here, which demands an explanation.

The first cause is obvious: immigrants bring fresh insights and methodologies from their old disciplines. This may include, in particular, a more fruitful way of telling apart wheat from chaff.

The second cause can be best approached by noting the resemblance between immigrants to a new discipline and to a new land. Foreign observers like Herodotus, de Tocqueville, or Margaret Mead sometimes see cultural aspects which are invisible to the natives. The natives live and breathe their customs; the perceptive foreigner doesn't. The same goes for the history of ideas: outsiders are less prone to ignore anomalies and to resist new conceptual frameworks.

An outsider's perspective, then, is particularly valuable at times of crisis. Such times are common. Indeed, there are good reasons to believe that no discipline is exempt from cycles of normalcy and revolution (Kuhn, 1970). Sometimes, an entire discipline is in intellectual disarray, e.g., pre-Copernican astronomy with its multitude of epicycles.

One could cite many historical periods of disciplinary crisis, but here I shall focus on the contemporary scene. According to some observers (Koestler, 1959; Schwartz, 1992), contemporary particle physics is in an unsettled state. The social sciences may also be in such a state. "The most prominent indicator of the crisis ... is the low wheat-to-chaff ratio in the glittering piles of research publications." Other indicators of crisis, according to this view, are controversies about everything and preoccupation with methodologies (Sherif, 1979, pp. 201–203). Another alleged candidate is education (Swoboda, 1979, p. 81; Whitlock, 1986, pp. 24–27).

Although these bleak assessments of contemporary particle physics, social science, and education could be mistaken, the history of ideas leaves little doubt that some fields are, or will be, in an unsettled state. The disarray may be more keenly felt and acted upon by newcomers who have not yet grown habituated to it—fresh recruits on the one hand, immigrants from other fields on the other.

Crossdisciplinary Oversights

> The gaps among [the social science] disciplines are much too large.... As a result, many sociologists ... [long continued] to draw their imagery of the Protestant Reformation from Max Weber, although professional historians have long since relegated his theories to the dustbin. In the same way, sociologists long continued to draw their imagery of primitive societies from *Patterns of Culture* far after the time when anthropologists had dismissed Benedict's ethnographic depictions as quite misleading. In neither case does the rejection of the work deny the intriguing quality of the conceptual scheme, but it does brand the specific historical or ethnographic accounts as so fallacious empirically that the concepts would not be utilized without the most careful reconsideration. And, both cases serve to illustrate how the gap between disciplines has led to one of them relying on theories and data which are quite invalidated among the originating discipline (Wax, 1969, pp. 81–82).

> Insulated from related disciplines and lacking a clear notion of its bearings relative to what others have done, intensive study within a single [social science] discipline

> sooner or later leads to floundering into territories already explored by others. The
> result is confusion and displays of needless ignorance, of the kind typified in the
> past by psychologists who improvised their own sociology of the family or of cul-
> ture, or who declared social institutions to be fictions (Sherif, 1979, p. 217).

The problem is by no means confined to the social sciences. At the turn of the
century some biologists believed that dominant genes would increase in frequency in
relation to recessive genes. In this case, the interdisciplinary corrective was put into
effect by the mathematician Hardy.

Nor is this predicament confined to the past. The writings of some contemporary
economists often fly in the face of basic ecological concepts. Most books, one noted
economist says,

> discussing environmental and resource problems begin with the proposition that
> there is an environmental and resource crisis. If this means that the situation of
> humanity is worse now than in the past, then the idea of a crisis—and all that fol-
> lows from it—is dead wrong. In almost every respect important to humanity, the
> trends have been improving, not deteriorating. [Therefore, global and U.S. trends
> will go on] improving instead of deteriorating.

Had our economist consulted an introductory logic text, he might have perceived
that this passage employs a persuasive definition of "crisis" (humanity's situation is
worse now than in the past), instead of the more appropriate lexical definition ("an
unstable state of affairs in which a decisive change is impending"—Webster Interna-
tional). Had he consulted a middle-of-the road ecology text, he might have realized
that this passage ignores the widely accepted theoretical definition of "crisis."

Or take the following lines, quoted approvingly in an eighth edition of a logic text.
"The school-book pictures of primitive man sometimes omit some of the detractions of
his primitive life—the pain, the disease, famine, the hard labor needed just to stay
alive." Now, the assertion about hard labor ignores anthropological findings that some
"primitive" tribes enjoyed much leisure.

Or take, finally, the key assertion in an influential, and otherwise excellent, educa-
tion treatise, that, of all the animals, "man is the only one to treat not only his actions
but his very self as the object of his reflection." A passing acquaintance with ape
behavior and, especially, with Gordon Gallup's work on self-awareness in chimpan-
zees and orangutans (Gallup, 1979), would have surely led this author to qualify both
this statement and its implications.

This comedy of errors could be expanded to fill volumes. Such oversights can be
found in works of the highest quality: they are part and parcel of the scholarly condi-
tion. In the non-existent world of pure disciplinarity, the people who commit such
errors and their colleagues, being strict disciplinarians, would have not been in a posi-
tion to catch them. And all those fancied strict disciplinarians who could spot such
errors would have never learned of their existence. Zealous divisions of this type are
of course fictional (Ruscio, 1986). The routine detection of crossdisciplinary over-
sights shows that we do not yet live in a pure disciplinary world. Nonetheless, the
oversights that do escape notice for years suggest that the world in which we do live is

not as interdisciplinary as it ought to be. Indeed, with more thinkers straddling more disciplines, and with greater tolerance for interdisciplinary conceptualizations and vocabularies, such embarrassing episodes would be less common than they are now (cf. Whitman, 1953).

Disciplinary Cracks

According to most interdisciplinary theorists, some problems of knowledge are neglected because they "fail to fit in with disciplinary boundaries thus falling in the interstices between them" (Huber, 1992, p. 285; see also Campbell, 1969; Kavaloski, 1979; Kockelmans, 1979). For instance, it seems reasonable to suppose that psychology has something to do with price raising, but, in 1977, this problem fell outside the domain of both psychology and economics; it therefore received insufficient attention (Boulding, 1977).

Before this sensible claim can be accepted, it must be borne out by the historical record. So far, this record is open to an opposite interpretation: potentially productive questions in No Man's Lands do eventually get attention. Witness, for example, the ongoing search for extraterrestrial life, which shifts along between astronomy and biology. Or witness explorations in scientific parapsychology, which fall between psychology and mysticism. Perhaps, as Ruscio (1986) argues, the disciplines are not in practice as sharply demarcated as most theorists suppose. Disciplinary researchers seem capable of filling productive, yet unoccupied, niches, so that the opportunities for fruitful research in the gray areas among the disciplines are perhaps not missed for long.

Regardless of the historical reality of unexplored gray areas, one point is perfectly clear: such areas include important topics which often require interdisciplinary research.

Complex or Practical Problems

Suppose that you wished to understand the Soviet-American Cold War. Suppose further that you were interested in fathoming this *entire* conflict, not merely one or another of its aspects. A few years and a few bookshelves later, you might realize that most experts have failed to arrive at a self-contained portrait because they examined this subject from a single disciplinary perspective. An integrated approach, you might conclude, holds a greater promise of bringing you closer to a firm grasp of this complex subject than any important but one-sided study. Thus, in this particular instance, you may begin with history. At some point of your ambitious undertaking, you would realize that history falls short, and that the Third World policies of both America and Russia are important to your subject. At another point you might conclude that the theories and practices of totalitarianism and democracy must be understood as well. You may prolong this branching out process for a while, until a reasonably coherent picture emerges. If you persevered, your broad synthesis may well embody a deeper understanding than any uni-disciplinary approach could possibly muster.

Or suppose you wanted to understand the nature of political liberties. You might examine the subject from a philosophical perspective, and, if you are an original

thinker, come up with some interesting observations. Or you might examine it from a historical standpoint, focusing perhaps on the conflict between Athens and Sparta, or between the Third Reich and France. Or, if you happened to be a science historian, you might focus on the similarities between scientific and democratic decision-making. All these disciplinary contributions may be valuable. But some hunters for truth go beyond this point: when *their* quarry ignores human-made "no trespassing" signs, they continue the chase. If, besides this interdisciplinary resolve, they also have an original mind, they may end up writing an epoch-making book on *the Open Society and its Enemies*.

In such cases, those who stop at the disciplinary edge run the risk of tunnel vision. Besides these obvious intellectual costs (cf. Saxe, 1945), narrow disciplinarity is frequently accompanied by a social cost. It is possible, for instance, that the high costs and risks humanity endured throughout the Cold War period are traceable in part to the tunnel vision of decision-makers and their academic advisors (Nissani, 1992). Humanity's use of new reproductive technologies is open to a similar interpretation:

> The failure to engage wisdom of an adequate breadth for addressing the subject at hand, along with the disciplinary norms that encourage such failure, are painfully evident even in the best of the recent books on the impact of the new reproductive technologies ... [books which] fail to transcend the narrow boundaries of their own argumentative fields to offer broad-based and widely comprehensible options for our collective future (Condit, 1993, p. 234).

Bertrand Russell's (1960, p. xv) characterization of politics may still merit our attention: "It is the custom among those who are called 'practical' men," he says, "to condemn any man capable of a wide survey as a visionary: no man is thought worthy of a voice in politics unless he ignores or does not know nine tenths of the most important relevant facts."

Even well-meaning statesmen may err because they do not understand the technical, social, or scientific aspects of a policy:

> It is dangerous to have two cultures which can't or don't communicate.... Scientists can give bad advice and decision-makers can't know whether it is good or bad. On the other hand, scientists in a divided culture provide a knowledge of some potentialities which is theirs alone. All this makes the political process more complex, and in some ways more dangerous, than we should be prepared to tolerate for long, either for the purposes of avoiding disasters, or for fulfilling ... a definable social hope (Snow, 1964b, p. 98).

The intellectual, social, and personal price of narrow compartmentalization has been often remarked upon (Boulding, 1977; Easton, 1991; Eliade, 1977; Gaff, 1989; Gass, 1972; Mayville, 1978; Petrie, 1986). Indeed, history might have been different if the experts who developed fire retardants in children's nightwear examined their mutagenic potential (Swoboda, 1979), if the people who put together the Aswan Dam had been trained to remember the large picture, if the people who marketed thalidomide looked beyond its tranquilizing and economic potential. An interdisciplinary background may have not caused industry experts to adopt a more balanced view of the tobacco/cancer link, but it might have tempered their outright advocacy of smoking.

In more general terms, "recent history is filled with cautionary tales [all showing] the dangerous, sometimes fatal, narrowness of policies recommended by those who possess expert knowledge." Experts prefer quantifiable variables, they tend to ignore contextual complexity, and their scope is often limited (Marx, 1989). All too often, experts forget that "problems of society do not come in discipline-shaped blocks" (Roy, 1979, p. 165).

Of the many episodes which capture our society's disciplinary dilemma in more personal terms, I should like to relate one. It involves a nuclear weapons scientist who gradually became alienated from his work. His epiphany came in

> the experience he had in the mid-1980s when visiting the Soviet Union for the first time: Walking in Red Square ... [seeing] so many young people ... he began to weep uncontrollably.... Before that, Moscow had been no more than a set of lines at various levels of rads and pressures and calories per square centimeter that one had to match with the bombs. (Lifton & Markusen, 1990, pp. 273-274)

Again, for all I know, the production of nuclear weapons could be justified on moral grounds, but this is not the point here. To democrats and humanitarians, the frightening point is this: in this world of specialists, a highly educated person can be unaware of the social and moral dimensions of her actions. H. G. Wells said someplace that history is a race between education and catastrophe, but this captures only part of our plight. Ironically, in this age, one may know much about a subject and yet know little about its ramifications. I for one know decent people who know everything about the chemistry of CFCs and nothing about the ozone layer (Nissani, 1996); everything about internal combustion engines and nothing about global warming; everything about minimum wage legislation and nothing about poverty. Compartmentalization, besides lack of education, is the enemy; an enemy that can only be conquered through holistic scholarship and education:

> Previously, men could be divided simply into the learned and the ignorant, those more or less the one, and those more or less the other. But your specialist cannot be brought in under either of these two categories. He is not learned, for he is formally ignorant of all that does not enter into his specialty; but neither is he ignorant, because he is "a scientist," and "knows" very well his own tiny portion of the universe. We shall have to say that he is a learned ignoramus, which is a very serious matter, as it implies that he is a person who is ignorant, not in the fashion of the ignorant man, but with all the petulance of one who is learned in his own special line (Ortega y Gassett, 1932).

To sum up. Many complex or practical problems can only be understood by pulling together insights and methodologies from a variety of disciplines. Those who forget this simple truth run the intellectual risk of tunnel vision and the social risk of irresponsible action. In some areas, interdisciplinary research has long been practiced, e.g., materials research or American studies. Such areas, and the habit of holistic vision they foster, should become more numerous. Future specialists will perhaps be able to see their field "as part of a wider context, to reflect on the impact of their discipline's

activities on society, and to enhance their ability to contribute to social developments"
(Huber, 1992, p. 290).

Unity of Knowledge

It is of course impossible, in our age, to become an expert in everything. But if we
mistake disciplinary knowledge for wisdom; if we forget how much we don't know; if
we forget how much we cannot know; if we don't set for ourselves, in principle at least,
the ideal of the unity of knowledge; we lose something of great importance. By persis-
tently aiming at the hazy target of omniscience, interdisciplinarians help us remember
these things. They thus spur us to see the various components of human knowledge for
what they are: pieces in a panoramic jigsaw puzzle. And they inspire us to recall that
"the power and majesty of nature in all its aspects is lost on him who contemplates it
merely in the detail of its parts, and not as a whole" (Pliny, 1977, p. 581).

Familiarity with other cultures enables us to see deficiencies in our own:

> The modern mind divides, specializes, thinks in categories: the Greek instinct was
> the opposite, to take the widest view, to see things as an organic whole.... It was
> *arete* that the [Olympic] games were designed to test the *arete* of the whole man,
> not a merely specialized skill.... The great event was the pentathalon, if you won
> this, you were a man. Needless to say, the Marathon race was never heard of until
> modern times: the Greeks would have regarded it as a monstrosity. As for the skill
> shown by modern champions in games like golf or billiard, the Greeks would cer-
> tainly have admired it intensely, and thought it an admirable thing—in a slave, sup-
> posing that one had no better use for a slave than to train him in this way.
> Impossible, he would say, to acquire skill like this and at the same time to live the
> proper life of a man and a citizen. It is this feeling that underlies Aristotle's claim
> that a gentleman should be able to play the flute but not too well (Kitto, 1957, pp.
> 173–174).

Flexibility of Research

Most fields experience exciting periods of rapid, sometimes revolutionary,
advances, followed by periods of comparative stagnation. Most people stick it out
through thick and thin; without their dedication, the world of culture would have been
in a sorry shape. (Although sometimes, as we have seen, immigrants bring fresh
perspectives and thereby contribute to their new subspecialties or disciplines.) Be that
as it may, in personal terms, individual scholars eager to migrate to a new discipline
enjoy greater flexibility and freedom in their career, an obvious personal reward of the
willingness to cross disciplinary boundaries.

Law of Diminishing Returns

The law of diminishing returns states that, beyond a certain point, the yield on fixed
increments of input gets progressively smaller. It takes hours to learn chess, months to
get to be reasonably good, and years to become an expert.

A similar situation seems to prevail in the world of learning. An insect anatomist,
for instance, must keep abreast of his field. He might have never read Tolstoy or

Plato; never heard Bach or Vivaldi. As a human being, he could undoubtedly gain more from getting acquainted with these authors and composers than from spending the same amount of time on insect anatomy. But life is short. In a better world, we would all have "world enough, and time." In this world, a champion marathoner, a concert master in a major orchestra, a Stakhanov, or a liver toxicologist, are the victims of the law of diminishing returns. To reach the pinnacle of their profession, they often end up exploring one interesting feature of a single atoll. Interdisciplinarians, by contrast, are forever treating themselves to the intellectual equivalent of exploring exotic lands.

Social Change

Although the modern university is rich in intellectual resources, it is only mildly effective as an agent of social change. One would expect a stronghold of professional thinkers to have a fundamental impact on politics, but it doesn't: the academy enjoys little success in mobilizing its vast intellectual resources to improve society.

The reasons for this are no doubt complex, but one among them is clear: "the fragmentation of the disciplines renders all of us passive before a world become increasingly obscure and arbitrary" (Birnbaum, 1986, pp. 65–66).

A community whose members speak a multitude of mutually unintelligible languages cannot build high towers; functionality requires effective communication (Hirsch, 1987). To transform theory into praxis, to tap the tremendous potential for progress and justice in the intellectual and artistic communities, channels of communication, and a common language, must be reinforced. Interdisciplinarians, by reminding us of the unity-of-knowledge ideal, by their mastery of two or more lingua academicas, may be able to contribute to a greater integration of the world of culture.

Academic Freedom

Cultural systems—like ecosystems—can be disrupted or destroyed by external interventions. "Too forceful a superimposition of the extrinsic values of accountability and relevance on the intrinsic values of reputation-seeking and quality control by peer group judgment can only lead to intellectual subservience, and thence to academic sterility. On the cognitive side of the equation, knowledge itself, viewed as a cultural resource, demands good husbandry and steady replenishment" (Becher, 1989, p. 169). Owing to the disciplinary fragmentation of the world of learning, academics fail to notice those larger threats to academic freedom which affect the academic community as a whole.

> To preserve even a modest degree of intellectual integrity, the enemy within should not remain unnoticed.... The problem remains of how to bridge the evident divisions and thus to promote that recognition of commonality which seems essential to the maintenance of some measure of collective independence.... An enhanced recognition of mutuality could serve as better defense against the intrusive managerialism which seeks to impose a crude form of accountability, based on false assumptions about the nature of intellectual endeavor, and bolstered by insensitive and often spurious "indicators of performance." It might even help to persuade the

wider society, on whose patronage the pursuit of knowledge ultimately depends, to maintain for academics a reasonable liberty—if one which remains well short of license—in their choice of what to study and how to study it (Becher, 1989, pp. 169–171)

If we accept Becher's analysis and share his concern for academic freedom, an additional advantage of interdisciplinary knowledge, research, and education, emerges: perhaps more than any other group within the academy, interdisciplinarians are posed to build bridges among the disciplines.

A BRIEF CASE AGAINST
INTERDISCIPLINARY KNOWLEDGE AND RESEARCH

At times, interdisciplinary perspectives may prove a handicap. Indiscriminate attempts to apply one discipline to others have often had unsavory consequences. Both Archimedes' physics and Spinoza's philosophy suffered for being clad in an ill-fitting mathematical dress. Evolutionary theory suffers because it contradicts religious beliefs. Some people believe that the social sciences could advance faster by blazing trails with their own axes, not with fancy imports from the natural sciences.

More often than not, amateurs and outsiders will miss an essential facet. They often blunder, as did the many "inventors" of perpetual-motion machines, the religious fundamentalists who dismissed Galileo's telescope on spurious grounds, alleged observers of UFOs, or the music lovers who rioted during early performances of Stravinsky's works.

Even under the best circumstances, an interdisciplinarian is unlikely to gain as complete a mastery of her broad area as the specialists upon whose work her own endeavor is based. She must risk dilettantism to gain her bird's eye view. She may become jack of all trades, master of none. Literary critics, for example, often borrow a theory from another discipline, even though they fail to "first understand what it means in that discipline and how it is judged there" (Levin, 1993, p. 33).

The impossible ideal of the unity of knowledge may lead some people to scorn the never-ending search for knowledge: since humanity's stock of knowledge cannot be mastered, and since reality itself must forever elude us, the quest for truth might be given up as misguided in principle. Also, ignorance in some cases is bliss. Knowing the negative consequences of their actions, interdisciplinarians may wrestle with dilemmas which are dimly perceived by their straight-and-narrow brethren. Fragmentation, on the other hand, renders mastery of a subject manageable, it helps us forget how much we cannot know, and it keeps us blissfully unaware of untoward repercussions.

An interdisciplinary dialogue runs the risk of going stale. The interdisciplinary community can become "cut off from fresh infusions of disciplinary knowledge." It can slide into naive generalism with little disciplinary training (Grant and Riesman, 1978, p. 35).

In some cases, interdisciplinary research requires cooperation of experts with different disciplinary backgrounds and different ways of thinking—a notoriously difficult undertaking.

Interdisciplinary knowledge and research are demanding. To keep reasonably abreast of just two fields, for instance, requires tremendous investment of time and intellectual energy.

BARRIERS TO INTERDISCIPLINARY KNOWLEDGE AND RESEARCH

In the world of learning as it is presently constituted, committed interdisciplinarians typically find themselves in a disciplinary environment. "Disciplines serve not only as a convenient ... way of dividing knowledge into its components, but ... they also serve as a basis for organizing the institution—and hence the professionals engaged in teaching and research—into autonomous fiefs" (Gass, 1979, p. 119). The consequences are predictable. In a recent case, the promoters of an interdisciplinary program were called upon to formally explain how their program would achieve *disciplinary* depth. Experts tend to view with suspicion people lacking a firm anchor in any discipline. Regardless of the quality of their work, interdisciplinarians often experience difficulties securing research grants, going on exchange programs, publishing, gaining recognition, securing a job, or being promoted: "Researchers who identify themselves professionally with cross-disciplinary categories face the entire panoply of gatekeeping mechanisms, which by and large favor existing disciplinary categories" (Klein, 1993, p. 193).

A few examples: The Fulbright Scholar Program has no interdisciplinary category—no interdisciplinarians need apply. "To be accepted, Piaget's seminal work had to be replicated in conformity to the American model" (Bechtel, 1986, pp. 22-23). It took 35 years for Mendel's work to be noticed (Nissani, 1994a). William James felt that "it seems a great pity that as original a man as [Charles Peirce] ... should be starved out of a career" (1952, p. 279). Isaac Asimov came close to being fired from an academic post for being a generalist. Asimov's case, however, is not nearly as tragic as Peirce's: Asimov not only kept his job, but, twenty-four years later, made the grade for full professor (Asimov, 1980, pp. 111, 798; see also Nissani, 1994b; Nissani, 1995b).

Unlike interdisciplinarity, specialization may be in harmony with Western tendencies "to compete, excel, dominate, and control" (Gusdorf, 1979, p. 147). People educated in our universities find it difficult to conceive of anything other than the current departmental structure. Promoters of interdisciplinary research and education must overcome their colleagues' resistance to change (Nissani, 1994b; Nissani and Hoefler-Nissani, 1992). In a world of limited resources, interdisciplinarians may be perceived as competitors. Disciplinarians may be perfectly content doing things their way and reluctant to labor for a devil they don't know. Inside and outside academia, the interdisciplinarians' concern with interconnections and the larger picture may be viewed as potentially subversive.

All these drawbacks and barriers explain the hostile reception of interdisciplinary initiatives (Roy, 1979, p. 167):

> Given the intractability of the departmental structure, the change resistance of faculty ... it is unlikely that modern universities can produce many graduates who will reflect the now elusive Renaissance ideal. There will of course continue to be those

rare human instances of extraordinary and comprehensive knowledge; but such people will emerge as much in spite of as because of universities (Miles, 1989, p. 17).

PRACTICAL IMPLICATIONS

Despite the barriers and drawbacks, the foregoing discussion forcefully calls for a mild shift (in both attitudes and institutional arrangements) towards interdisciplinary knowledge and research. To overcome the negative sides of specialization, to retain its vitality, the academy must cultivate interdisciplinary knowledge and research. It must never forget that a vibrant community of scholars—just like a thriving ecosystem—nurtures specialists and generalists, diversity and interconnections.

No doubt, most academics "will go on tending their own garden" (Sherif, 1979, p. 218). This is all as it should be, provided these specialists "force themselves to define all of the available research on that problem as of possible relevance, and to see themselves as contributing to the resolution of a problem rather than as adding information to an isolated discipline" (Condit, 1993, pp. 245–246). No doubt too, and despite the hardships, a few creative individuals will continue to tread from one garden to another. We should see to it that their less-traveled paths are not overrun with thistles.

The case for interdisciplinary education, it seems to me, is not as straightforward as its knowledge and research counterparts. Because educational philosophies are shaped in part by ideology, intuition, and aesthetics, the controversy about the extent, timing, and need for holistic education may well be irresolvable. Here I can do no more than offer a personal view. The soundest course of action may again involve enriching the vast disciplinary archipelago with idiosyncrasies and bridges. At the global level, this implies a wide range of disciplinary and interdisciplinary educational programs. At the institutional level, this implies encouraging students to take at least one consciously integrative course.

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