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Broad horizons – SETI, SF and education

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Abstract: Science fiction (SF) is often perceived as a 'fringe' form of entertainment that excites the socially challenged. This misperception detracts from the critical, scientific and interpretive nature of the genre which can be directed into science teaching at school and university levels as an innovative way of exploring the cultural background, politics, leitmotif and themes of society, science and their operation. One example is the 'alien' theme in SF; it is perceptually one of the driving factors in the search for extraterrestrial intelligence (SETI). Such a topic can become an introduction to current technology, the motives and politics of science and the sociological implications inherent in a confrontation with the ideal of man's uniqueness in the cosmos. When applied to the SETI, SF engenders a constructive convergence in studies such as biological determinism, the evolution of life, communication, interstellar travel and methods of contact, thus enriching the consideration of possible life in the cosmos. Adopting elements of SF in lifelong learning therefore enables informed, imaginative reflection and debate that educates, trains and instructs, broadening the potential of students and their future roles by invoking an analysis of vital public, scientific and humanistic fields.

'*Imagination lies at the basis of all discovery*'

Octavio Paz

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Introduction

Science fiction (SF) has many definitions, but one of the greatest from the perspective of educators is that of Joanna Russ, who defined SF as 'a literature that attempts to assimilate imaginatively, scientific knowledge about reality and the scientific method, as distinct from the merely practical changes science has made in our lives' (Russ 1995, p. 7). It is this imaginative approach that characterizes SF's appeal as a widening genre that affects all who come in contact with it. The phenomenal success of the highest grossing films such as *Star Wars*, *Independence Day*, *Jurassic Park*, *ET*, *Close Encounters* and many more attest to the success of not only its value as entertainment, but its ability to excite, fascinate and encompass original values.

SF as a literary text is equal to, if not greater than, the impact of these movies upon human consciousness. Perceived as initially being a 'western' phenomenon, the rise of SF within the industrialized world is a reflection of the cultural modes linking society, science and technology together, so that it has grown with these forces, expressing and evaluating them, and relating them meaningfully to human existence (Franklin 1966, p. 1). As the world moves towards increasing dependency on industry and commerce, globalized human society finds an outlet for its anxiety, uncertainties and angst via the social criticism and 'what if?' premise of SF. The dawn of the 21st century has heralded the implementation of many scientific techniques and ideals discussed in the best SF novels, leading to a unique insight that is often misread as prophetic. SF is not prophetic. Rather it is creative and innovative, addressing complex human questions regarding our role in the cosmos which is both cross-curricular and invigorating, demanding a widening knowledge of various disciplines and drawing together the disparate strands of science and the humanities, so as to generate application to our modern world and its broadening horizons.

Science fiction and education – breaking the barriers

Former SF writer Jack Williamson (1980) expresses the appeal of SF and its utility in education in his book *Education for the Future – Teaching Science Fiction*. SF, he claims, ''has a timely sense of realism that is lacking from so-called 'realistic' fiction (e.g., the novels of Harold Robbins) and establishes the thought that, however unreal or weird its machines or alien motifs may appear, it drives the acknowledgement that technology and imagination are changing our world. SF also allows us to think the unthinkable, to explore a scenario from different viewpoints without having to experience the horrors of the reality of such schemes'' (apocalyptic SF for example). Additionally, SF offers us

freedom to think and to say what we think without inhibitions. In society today, pressures to conform are stifling and are especially felt at school levels where peer pressure can have distinct disadvantages. SF becomes a leveller where common themes and complex attitudes can be appropriately investigated via a selected text and openly discussed in a class environment without stigma, possibly leading to extra-curricular reading and enjoyable research. Literature and film texts can be enjoyed in an educational setting, injecting a diversion from traditional texts widely considered by the youth of today as 'boring' or outdated, possibly opening the genre, its ideologies and its 'scientific content' to wider application. Lastly, SF is 'international in appeal, revealing that we are inhabitants of one planet in an infinite cosmos. It clarifies our jealousies, our class distinctions, divisions of race, religion and nation and throws a harsh and critical light upon our human attitudes toward ourselves and our role in the universe' (Williamson 1980, p. 10).

Thus the value of SF and its inclusion in the curriculum can be interpreted as an essential part of our education, especially one in which schooling promotes discriminating faculties that are later applied in life. Some of the greatest scientists in 20th century research were propelled into their respective disciplines by the vigorous speculation found in SF. This in turn has resulted in many influential scientists reflecting upon and popularizing their fields via accessible science texts and common journals, increasing the public understanding of science, occasionally drawing on the common motifs and examples of SF and filling a public thirst for accurate knowledge that otherwise would become occupied with pseudo-scientific ideologies, to the detriment of educational desires. Carl Sagan (1997), astronomer and SETI advocate, addresses these concerns in his book *The Demon Haunted World – Science as a Candle in the Dark*. Sagan not only stresses the importance of science education in our technological society, but also illustrates the capacity of SF to draw ingenious parallels and connections to modern science. He admits to considering himself as fortunate to have been influenced by SF when a child. He ponders that 'the greatest human significance of SF may be as experiments on the future, as explorations of alternative destinies, as attempts to minimize future shock. The fact that some SF is not of the highest quality is irrelevant, 10 year olds do not read the scientific journals' (Sagan 1997, p. 23).

This is a good point. It is essential that the *ideas* prevalent in SF rather than the stories themselves are used in such a fashion as to produce insight into the world around us. One contemporary author, Thomas Disch (1998: 21), argues that, to enable a reconciliation and analogy between the imaginary world and the real one, SF must be both thought provoking and bewitching (Disch 1998). Discussing the contribution to popular culture of the TV show *Star Trek* as an example, he draws on the venom of Peter Nicholls who slates the show as 'unimaginative SF pandering to the Anglo-Saxon Protestant, middle class manner' (Nicholls 1979, p. 278). *Star Trek* is often assumed by critics to be SF at its most unassuming and least challenging. Disch, however, ponders this problem from an alternate standpoint, proclaiming: 'a challenge is traditionally the prelude to a duel, not to a half hour of light entertainment. The first order of business is not to challenge but to entice' (Disch 1998, p. 98). Generating an attraction for and enjoyment of a subject is one of the first hurdles any teacher faces. The use of SF may entice students to reconsider their first impressions of a topic.

Returning to our *Star Trek* example, what can we learn from such a mediocre show? Disch cleverly turns Nicholls reasoning on its head, not by defending *Star Trek* but by determining the nature and content of such space opera shows in an analytical fashion that questions our perceptions. Teachers would do well to follow his pattern rather than dismiss such programmes or literature out of hand. Precisely what *Star Trek* does *is* entertain and entice; a little dissection probes the mores behind the *Star Trek* image in the original series, Internationalism in space exploration can be discerned in the inclusion of Russians, Americans, Chinese and Black people amongst the crew; the frontiership and moral questions posed by the series appeals to a generation growing up with the reality of space travel. Contact with aliens is generally portrayed in a negative fashion by the show, but is this necessary? Spock, the unemotive alien member of the crew is a handy foil illuminating our human emotional attributes, yet explicitly establishes in almost every instalment the fact that logic and the application of science alone does not always lead to successful conclusions in real-life situations. These themes continue in the spin off series, *Voyager*, *TNG*, *DS9* and now *Enterprise* empowering us to penetrate our evolving social codes and the religious and political images of our respective cultures. Although the series might not be good science, it is, from an educational viewpoint, valuable as a lesson reflecting our human desires and aspirations in a world increasingly overtaken by science and technology. In the *Star Trek* universe there is no poverty, hunger, discrimination or disease, a direct contrast to the real world around us (Richards 1997, p. 8). Could this utopian ideal become realized? How will it be achieved? What political, scientific and sociological methods require application? Such a point of debate is just one reason to include a SF motif in the classroom. This is not to state that we should impose the inclusion of *Star Trek* on the curriculum. It is merely an example of how SF, as a supplement to the curriculum, can be utilized as a key to education, with conjecture leading to attraction and enjoyment of the subject or task at hand.

More difficult concepts with subjective overtones can be illuminated with the spotlight of science fiction. Sectors of our civilization are concerned with the effects of industry, politics, economics and technology on the environment, whilst one of the most chilling possibilities of scientific research, human cloning and genetic manipulation, are a constant feature of news items. Science fiction has addressed these concerns, reflecting and evaluating our environmental impact, clarifying issues, warning of the consequences of misuse, questioning the validity of technological progress and penetrating the 'tunnel vision' approach that hoodwinks

the public into a blind faith in scientific progress to the detriment of the world we inhabit (Disch 1973, p. 14). It is perhaps understandable in this light that many ordinary people are fearful of the power of science and its so-called advances. Pamela Sargent (1976) has questioned the imagined 'progress' of science in her anthology *Bio-futures*, reflecting that we live in an age of scientific horrors which are out of common control and which devolve upon our elected representatives to cope with on our behalf; representatives who for the most part, have as little understanding of science and its consequences as the man in the street. She claims that our 'apprehensions may be better directed towards what governments and various agencies might do with their knowledge, rather than worry about the developments themselves' (Sargent 1976, p. xvii), a claim which introduces a political dynamic into the classroom, allowing the voters of the future an informed angle on the ethical, moral, philosophical and political consequences of the actions of the establishment.

Supplementary evidence of the educational value of SF can be examined in the light of alternate histories or counterfactuals; stories which turn the accepted models of history on their heads by investigating different perspectives, such as the Nazi's winning World War Two or the Confederacy winning the American Civil War. What could such altered histories teach us? Gardner Dozois and Stanley Schmidt argue 'alternate histories in SF can spark lively political debate, and by examining how things did not happen, may shed light on the reasons things did happen the way they are portrayed in commonly accepted history. SF becomes a valuable teaching tool, a great way to incite curiosity in students and historians alike' (Dozois & Schmidt 1998, p. xiv). The SF writer John Brunner (1976) alludes to the penetrative future themes of SF and its value in society by quoting a speech by the Member of Parliament Raymond Fletcher to the 1970 SF convention in London. Fletcher noted that the social criticism of quality SF may 'dramatize for government planners the social implications of new town plans, population projections, and the rest of the dry statistical matter involved in long-term forecasting, in the hope that decisions would be reached with a keener understanding of the drawbacks for the individual' (Brunner 1976, p. 6).

It can be appreciated from the foregoing arguments that SF is utilitarian, a tool for achieving certain educative purposes which are not solely related to SF. Generating enthusiasm for a subject via the lessons implicit in SF ensures participation, communication of ideas, pleasure of research, correlation and application of data, lateral thinking ability, critical analysis and social interaction, along with many other key life skills such as comprehension, reading ability and increased vocabulary.

It can be argued that scientific, or even seemingly scientific, *conceptions*, when encountered in youth, can influence adult behaviour. The youth of today are the adults of tomorrow. What sort of world will they inhabit? Will they shape the destiny of mankind by utilizing the visions of SF? The values of our society change from generation to generation, evolving and re-evaluating what is moral, ethical and acceptable in conjunction with emerging philosophies and technologies. 'In the course of our natural evolution we may or may not achieve a higher, more harmonious state in keeping with our 'civilized' concepts, but our race cannot depend on that, and the individual cannot wait for it; we must remake ourselves, and SF is a signpost directing the way' (Ettinger 1972, p. 21). Isaac Asimov and Robert Heinlein both claimed that SF is the literature of change, and it is the ability to cope with such changes that will enable mankind to enter the technological future with faith in his adaptability to new challenges. To some extent we already live in a world modelled by these motifs. Sargent claims that SF has already warned us of the dangers of change, whilst at the same time legitimizing the concept (Sargent 1976, p. xx). What revelation does contemporary SF hold for our future? What novelties can be found within the genre that apply to our culture? People educated with these patterns can face the future with confidence. They may not be astounded if we were to receive a message from an extraterrestrial civilization, artificial intelligence may become commonplace, man may overcome the environmental problems we currently face, our children may live in a globalized Utopian society; many of the hundreds of 'prognostications' of SF may come to pass – the point being that they have already been accommodated to these possibilities by their implementation of the lessons inherent in SF. They are conscious of the outward urge of man's endeavours, clearly informed of the possibilities and drawbacks of scientific, technological, ecological, humanitarian or political progress, adapting to and comprehending a society in which they can play a dynamic, purposeful role.

Science and SF in the curriculum

With these ideals in mind, The University of Glamorgan has introduced a resourceful programme exploring the relationship between science and SF and its application to lifelong learning. As a theme for undergraduate study, science is a giant within the academic world. It has acquired a generic status through representing not only its constituent and pure knowledge areas – such as mathematics, physics, chemistry and biology – but also because of a methodological paradigm associated with the pursuit of truth through systematic attempts to publicly refute or verify hypotheses and theories.

Science also extends beyond the laboratory, the academic community and associated scientific professions: it positions itself within popular culture. Scientific discoveries, problems and methods fascinate the general public. Museums, interactive science centres, television documentaries, toys and books have become artefacts for popular understanding of scientific facts. Interpretations and explanations of scientific phenomena may not be consistent, rigorous or accurate within such texts or institutions, yet nevertheless many people within a wide range of communities believe themselves to be scientific in their arguments and competent in their grasp

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of key issues and principles due to such popularization. At the most extreme levels these beliefs constitute a communal sense: one in which scientific 'truths' are promulgated, leading to a public assumption that such truths are verified by an expert scientific community. In reality, the methods and reasoning directing these assumptions are contradictory or non-existent on many occasions. Critical analysis and lateral thinking are required to place these assumptions in their correct context.

Many traditions and perspectives within social science question the positioning of scientific knowledge within society and within popular culture. A common dialectic is used: science against art and the continual comparison of paradigms associated with what at first seem to be such different traditions within academia. An effective technique for exploring this kind of academic debate involves a critical exploration of the boundaries and barriers which define what, at first glance, appear to be discrete subject areas and methodologies. We lament this kind of 'Intellectual Ghettoizing', to coin a phrase of Robin Wilson 1996 of Ohio State University, wherein the results are displayed as a lack of vision, understanding, cohesion and appreciation of the endeavours and accomplishments of disparate fields of learning. How can anyone participate in the public decision-making process if they are so ignorant of the scientific, technological, aesthetic, historical and philosophical components involved in such debates? It is essential that education takes a cross-curricular approach that addresses these areas.

Our degree award pursues such areas, and seeks a critical but multidisciplinary understanding of SF genres and texts whilst continually testing out the validity and appropriateness of scientific theories and methods. In so doing, students and their teachers explore a multitude of links between deductive and inductive reasoning, truths and half-truths, the actual and the possible, and ultimately between science, faith, prophesy, pseudo-science and fantasy.

The use of a broad theme for the application of scientific ideas and methods is becoming commonplace within higher education. At the most powerful levels it has led to the creation of new disciplines associated with, for example, the study of behaviour (psychology) and society (sociology). The selection of SF represents a new endeavour within our own academic community, and it represents an important challenge to conventional curriculum design. There is a wealth of knowledge and evidence to draw upon within this academic pursuit, in addition to contemporary myths and controversies that span numerous subject and discipline boundaries. Furthermore, popular beliefs and common assumptions have to be rigorously challenged and analysed at the outset, simply because SF has acquired such a prominent profile within non-academic communities, mass media audiences and what might be loosely referred to as fringe ideologies.

This contextual experience with SF led to the creation of an entire minor and joint honours pathway in astronomy which is now contained within the University of Glamorgan's curriculum portfolio. Details of our innovative astronomy programme were reported to the *XX Symposium of the International Astronomical Union* in London (Brake 1996) and the *110th National Conference of the Astronomical Society of the Pacific* in Albuquerque, New Mexico (Brake 1998). The programme has attracted much interest from students as well as staff, where it was quickly realized that SF is a recurring and even dominant academic theme leading to informed discussion. Furthermore, other faculties have much relevance to the critical analysis of issues and perspectives emerging out of SF. Staff from the Schools of Humanities and Social Sciences, the Built Environment, Computing, Mathematics, the Centre for Lifelong Learning (CeLL) and from Pontypridd College's Glamorgan College of Art and Design Technology formed an informal discussion network which strengthened and developed confidence about actually proposing a complete degree award dedicated to this curriculum area.

Taught to an ever-increasing student intake since the autumn of 1999, this degree is an award *about* science as much as it is an award *in* science, since it encompasses the multifarious influences brought to bear on the continuous creation and consumption of science. In particular, the award uses a number of contrasting methodologies to explore the relationship between science, culture and society. The SF modules provide, in one sense, an imaginative forum that focuses on this relationship, enabling the student and tutor alike to examine the modern world from an alternate, informed and judicious perspective.

This course has received wider application than the higher-education level, becoming relevant to lifelong learning throughout the South Wales area since 1998. This has been achieved by the introduction at primary and secondary school level of the lessons discussed above via the innovative learning environment of the *Starlab* Planetarium, a mobile inflatable planetarium dome by way of which the cross-curricular lessons detailed in this paper have been practiced. Since its inception, over 10 000 children of ages 6–18 have had access to this resource (Griffiths *et al.* 2001, p. 10) provoking favourable comment from teachers and students alike, who have utilized the novel environment of the Starlab to develop a sustained interest in science, fiction and associated subjects beyond the class environment.

Starlab has recently been supplemented with the University of Glamorgan's *Robolab* – a collection of eight robot kits with allied laptops and software which enable students of ages 11–18 to develop skills in electronics, construction, teamwork, communication, lateral thinking, product application, engineering and IT development via the environment of a simulated Martian landscape, attaining the goal of building and programming a robot to carry out specific rescue tasks in a situation which is not merely lifted straight out of science fiction, but could become valid as mankind moves ever nearer to human exploration of the red planet. These themes have been further explored during the University's Space School, a forum for space science education drawing GCSE A level students from across the UK and Ireland in the summer of 2001, and again recently

in primary schools during a 5 week exhibition at a local museum. The Robolab had further application to educational initiative in 2002 when it become a part of the *Star Trek: Federation Science* interactive exhibit at the National Museum of Wales.

The university also has a very successful student outreach programme, with over 150 part-time students in various community centres across South Wales partaking of the modules of the degree. One of the most successful of such modules, both on campus and in the community, is that of '*Life in the Universe*'. Within this forum, human biology, biochemistry and origins are discussed and analysed within the framework of the philosophical, political and religious implications arising from Darwinian theory before the 'alien' theme is introduced, explored and contrasted via pluralistic speculation, the Drake equation, SETI and the societal repercussions of contact with extraterrestrial intelligence.

In 2003 the university secured £213 000 of European Social Funding to teach a tailor made astrobiology module in the community. This module, entitled *Alien Worlds* has attracted 350 beneficiaries of ages from 16+ who could engage in science education, review and discuss political and sociological options and learn more about astronomy, biology and related subjects. The use of SF and its imaginative role in SETI featured alongside these fields.

At this time, further funding is at the bidding stage to take the module to a wider audience of 400 learners in the South Wales area. The success of the module so far reveals both a thirst for constructive and interesting education amongst the adult populace and the public attention being accorded the field of astrobiology.

How does SF play such a role? How useful can the contemplation of life elsewhere be?

Imaginative literature and SETI

By virtue of its ability to project and dramatize, SF has been a particularly effective, and perhaps the only, means for generating concern and deliberation about the social, philosophical and moral consequences of alien contact. These mores may be extrapolated to current research, with application to SETI especially, as this is one area in which, in the public imagination at least, science fact may fulfil the science fantasies of our youth. Aliens abound in our common culture, despite the fact that we currently have no evidence for their existence. Alien life forms extend from such humanist manifestations as the Selenites described by Kepler in *Somnium* and Voltaire's giants in *Micromegas*, mere extrapolations of ourselves, to the thoroughly alien in such novels as Stanislaw Lem's *Solaris* and Arthur C. Clarke's 'Overminds' in *Childhood's End*. SF allows us to explore the relationship of humanity to the cosmos and to other possible forms of life in the universe, although it must be admitted that in our modern special-effects-filled technologically marvellous society we do not wish to find the ordinary out there, rather we wish to find the strange, the esoteric and the truly *alien*.

The inception of the Darwinian theory of evolution in 1859 gave credence not just to the evolution of life on Earth, but also to the physical evolution of worlds in a cosmic setting. Darwin's ideas have since inspired not only a wealth of fiction, but have provided a fictional rationale for imagining what kind of cosmic life might develop (Henkin 1963, p. 38). Since the 17th century, the 'alien' as distinct from, yet contiguous with, a human presence in the cosmos has given rise to a cultural idea, a *meme* as Blackmore describes it, which has been conjectured, established and enlarged until it has become a part of our intellectual heritage, a *memeplex* which now grips humanity (Blackmore 1999, p. 22). This 'ET meme' has since become a common factor to experience, relate and analyse through the medium of SF. From Darwin onwards, the age-old idea of plurality became synonymous with the physical and mental characteristics of the alien, establishing, for the first time, a memeplex of extraterrestrialism and engendering consideration of different forms of life both within the biological sciences and SF. The cultural attachment of the alien is one of the most interesting and engaging examinations that can be undertaken. The idea of other beings, separate, non-human and inhabiting far away worlds, is a feature of the pluralist debate, which arose after the Copernican revolution demolished the ancient Aristotelian idea of the uniqueness of the Earth and its cosmic context (Kuhn 1957, p. 89).

Despite Kepler's Selenites and Voltaire's Sirians, the modern alien with its distinctive physiology and intellect owes almost everything to the ET meme and Darwin. Daniel Dennett, Professor of Arts and Sciences at Tufts University, likens Darwinism and its implications to a 'universal acid' that eats through our cherished cultural, philosophical and biological ideals when we deal with our apparent uniqueness or singularity in the cosmos (Dennett 1996, p. 66). SF, more than any other form of literature, utilizes this acidity to expose, through biological speculation and fantasy, the current determinist outlook that the ET meme posits. This is most clearly exemplified by the speed with which SF authors utilized evolution to imagine alien life and the role of humanity. This is certainly the case with H.G. Wells and his 1898 novel *War of the Worlds*. First serialized in 1897 at the same time as the publication of Kurd Lasswitz's book *Auf Zwei Planeten* (On Two Planets), Wells arguably produced the first prototype of the personification of extraterrestrialism in devising not just the first alien fiction, but also the first 'menace from space'. Wells had a direct link to Darwin through T.H. Huxley (champion of evolutionary theory, often known as 'Darwin's Bulldog') who taught Wells from 1883 to 1886 at the Royal College of Science in London. Wells was well aware of the plurality of worlds philosophy through the works of Kepler, Richard Proctor, Flammarion and, perhaps most importantly of all, Percival Lowell, whose spurious Mars contention had recently reached Europe. Indeed, Wells had contributed to the plurality of worlds debate as early as 1888 when he addressed the Royal College of Science's Debate Society on the topic '*Are the Planets Habitable?*', subsequently writing a number

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of essays in support of the ET meme up to the publication of *WOTW* ten years later. Consequently, rather than being a capricious work of fiction, *WOTW* repeatedly reminds us of our insignificance in an immense universe along with our implied relegation on the new-found cosmic chain of being – 'minds that are to our minds as ours are to the beasts that perish' (Wells 1898, p. 2).

The impact of Wells' work cannot be over-estimated. Inspiration of many imitations, *WOTW* signals both the origins of the alien meme in fiction and its subsequent currency in the public imagination. Wells was largely responsible for introducing the science-fictional nexus of the new meme, armed with its potential for probing human evolution. Moreover, as Isaacs points out, Wells' early books 'are, in their degree, myths; and Mr Wells is a myth-maker' (Isaacs 1977, p. 33). Once developed, the alien meme proved a potent motif for fictional explorations of the singularity or insignificance of humanity cultivated by the ET meme, certainly a debate that echoes down to our day. Truly, during such explorations, the secondary question of the character of alien and interspecies interaction became an issue, which later affected the SETI programme.

One of the foremost poets of such progress was British philosopher Olaf Stapledon. Based in Liverpool, Stapledon used the alien meme both to highlight the new perspective on humanity afforded by the pluralism of the ET meme and to investigate the philosophical, spiritual and scientific issues arising in two key works: *Last and First Men* (1930) and *Star Maker* (1937). In his preface to *Last and First Men* Stapledon informs the reader that the narrative is an attempt 'to see the human race in its cosmic setting, and to mould our hearts to entertain new values'. In a telling evocation of both evolutionary theory and pluralism, he suggests that such attempts to extrapolate man's evolutionary future 'must take into account whatever contemporary science has to say about man's own nature and his physical environment'. As Isaacs (1977, p. 44) points out, Stapledon produced a fiction that incorporated the most recent ideas of astronomy and evolutionary biology and synthesized a new form of myth apposite to a sceptical and scientifically cultured 20th century. In the words of Stapledon himself, the aim must not be just 'to create aesthetically admirable fiction, but myth'.

As with *Last and First Men*, the presence of the alien meme in *Star Maker* is, again in the words of Stapledon himself, to 'explore the depths of the physical universe' and to 'discover what part life and mind were actually playing among the stars'. The contemporary setting in which *Star Maker* was conceived had undergone a further, though more silent, cosmological revolution. As Dick (1993, p. 254) has pointed out, it was not until the late 1950s that astronomers started drawing analogies between profound revolutions in the cosmological worldview and the impact of discovering extraterrestrial intelligence. Stapledon was 20 years ahead of the game. Shapley (1958, p. 76) proposed that contact would represent 'The Fourth Adjustment' in humanity's outlook, following the shift to the geocentric, heliocentric and 'galactocentric' worldviews. This latter revolution, hastened by Shapley's own discoveries showing that our local solar system was merely at the edge of our Galaxy and that the Galaxy itself was but one of many, was made just prior to the time Stapledon was writing *Star Maker*. Struve (1961, p. 12) concurred that astronomy had undergone great revolutions, the Copernican, the galactocentric and Hubble's discovery of an expanding cosmos of island universes, and that there was one massive upheaval yet to come, the ET meme embodied in the question 'Are We Alone in the Universe?' But the revolution had already begun with Stapledon. Berenzden (1975, p. 72) has suggested that by the mid-1920s revolutions, including those of Copernicus, Darwin, Einstein and Freud, had inured the masses to marginalization. Stapledon was preparing the public for the final great demotion and in the process helped develop the memic myth of the close encounter of the third kind: physical contact.

In *Star Maker*, alien biologies, together with terrestrials, search for the supreme intelligence in the new universe. Stapledon's (1937: 138) narrative can be clearly interpreted as an exploration of the ET meme and the quest for the spirit of the cosmos, an entity at the head of a new, and cosmic, great chain of being. In an early evocation of the implicit inhumanity of the new universe, he writes 'it was becoming clear to us that if the cosmos had any lord at all, he was not that spirit [God], but some other, whose purpose in creating the endless fountain of worlds was not fatherly toward the beings that he made, but alien, inhuman, dark'. Stapledon's fiction, then, emphasized the triviality of humanity in the face of a new and vast cosmos, which itself may harbour truths and meaning as yet unknown to an immature terrestrial race.

His fiction on the question of intellectual contact with alien biologies had great influence on working scientists, such as exobiologist J.B.S. Haldane and Carl Sagan, one of the founders of the scientific search program SETI in the early 1960s, and fiction writers from Arthur C. Clarke and Fred Hoyle to the modern day. The application of imaginative literature to the curriculum may well inspire budding scientists to break new scientific ground in the manner of these visionaries.

We have used SF to clarify SETI and the issue of plurality in the above examples, although it does not require much application to discover that the same themes are also useful as points of discussion for philosophy, religion, politics, colonialism and expansionism, space travel, environmentalism, evolution and biology (human or alien), postmodern trends in society and a host of other factors. Science fiction writer Theodore Sturgeon once professed such cross-curricular application when he stated: 'A science fiction story is a story built around human beings, with human problems and human solutions which could not have happened without their scientific content' (Schmidt 1977, p. 28). The *human* approach is emphasized here and our *human* projections and aspirations that have an effect upon our society here on Earth. Science fiction provides a forum for the debate of these disparate topics, bringing a knowledge of many disciplines

together to arrive at a whole; even if that whole is subjective to our experience and desires, it remains applicable to our global society in the light of scientific advancement.

Conclusions

The social, political and economic impingement of science and technology on society should be given careful attention, and the behaviour of a new gadget minimized' says Robert Slocum in his essay addressing the works of John Brunner (Slocum 1975, p. 147). This is an argument any layman would concur with, yet the general ignorance of such themes is precisely why we need to increase the stature of public understanding in science. Unfortunately, by the time we gain sufficient experience to balance up scientific, technological, political or economic initiatives and examine them dispassionately, usually with hindsight, the damage is already done. By then we have long entered the world of adulthood and have made crucial and often irreversible decisions on employment, sociology, choice of technology and application, and the election of representatives who are as unfamiliar with the motifs of science as are we. Clearly in our modern society, dominated by the world of science, such ignorance is unacceptable and damaging to future generations who are to follow us.

The lessons inherent in SF can be utilized to illuminate the tensions and fears that new developments can bring. This does not suggest that SF is prophetic and will warn us in advance of the maturation of such devices or industries, merely that the rationalizations realized in current or past SF are a means to inculcate the next generation with a critical faculty and insight that may slow the headlong rush, the ideology that 'if it's possible, let's do it' without weighing the consequences. The historical and political motifs of this literature enable the student to compare and contrast the current sociological and political ideals and draw educated conclusions, to perhaps even provide a personal guide for the selection of representatives similarly imbued with a sensitivity to our responsibilities. This may be a naive realization, but the possibilities nevertheless are there.

The segregation of subjects at school and university level has led to a lack of appreciation of the values of each subject. Our world does not run on mere knowledge alone; human beings are not machines who pack their minds with a specialized form of accepted wisdom and merely work *ad infinitum* at one method. We are gregarious creatures who require a wide variety of disciplines to make sense of our world and bring a measure of personal control to it. The ability to derive and apply a cross-disciplinary education is being lost at the expense of academic overspecialization and increasing public isolation. In evolution, the lesson is clear – overspecialization leads to disaster in a climate of rapid change. What could have more impact upon our political, environmental and sociological climate than the advances of science and technology throughout the 20th century?

This 'brave new world' can be addressed by the thoughtful and innovative application of the lessons of SF. Opening our minds to the possibilities of the future is not only the remit of SF authors, it is the honourable duty of educators of all disciplines to live up to the challenge.

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