Cosmic Humanity

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ABSTRACT

Over the next thousand years the domain of humanity will increasingly spread to the stars, a process that will alter our future in profound ways. At least three factors will drive this expansion: 1) increased understanding of cosmic evolution, changing our perception of ourselves and our place in the universe; 2) contact with extraterrestrial intelligence, bringing knowledge, wisdom, and problems of culture contact now unforeseen; and 3) interstellar travel, transporting humanity's emissaries to at least the nearest stars. The consequences of these events are not predictable in detail, but may be studied by examining the lessons of cosmic evolution; by using history to analyze the reception of new worldviews and intellectual culture contacts on Earth; and by anticipating the likelihood of success in interstellar travel and its effects. The prospect of Interstellar Humanity during the next millennium is likely to have an effect on all branches of terrestrial endeavor, whether religion, philosophy, science, or the arts. The stage of human drama will be vastly expanded.

Introduction

Fifty years ago the British philosopher and science fiction writer Olaf Stapledon wrote his essay "Interplanetary Man." At the brink of the Space Age, Stapledon, best known for his *Last and First Men* (1930) and *Star Maker* (1937) epics, believed that humanity would spread throughout the solar system over the next few centuries, barring the destruction of civilization made possible by the new atomic age. He realized that expansion of the human domain would be very different depending on whether or not the planets were inhabited; he concluded, in line with scientific thinking of his time, that this was very unlikely.

Humanity would therefore be left to colonize the planets of our system, most likely unencumbered by problems of extraterrestrial contact; the question that exercised Stapledon was humanity's use of the planets. Exploitation of physical resources, power over a larger physical domain, and the satisfaction of curiosity would all be part of it, but Stapledon believed the solar system was destined for more than mere extension of life as it existed on Earth. Man should use other worlds not for the sole purpose of increasing luxury or power, but "should avail himself of their resources in such ways as to advance the expression of the spirit in the life of mankind. He should use them so as to afford to every human being the greatest possible opportunity for developing and expressing his distinctively human capacity as an instrument of the spirit, as a centre of sensitive and intelligent awareness of the objective universe, as a centre of love of all lovely things, and of creative action for the spirit."[1]

But Stapledon had more in mind than simply a wider scope for *Homo sapiens*. An avid reader since his undergraduate days of genetic pioneers Gregor Mendel, Francis Galton, and August Weismann, he believed that through eugenics specially adapted human or quasi-human races should be developed. "Thus the goal for the solar system would seem to be that it should become an interplanetary community of very diverse worlds each inhabited by its appropriate race of intelligent beings, its characteristic 'humanity,' and each contributing to the common experience its characteristic view of the universe. Through the pooling of this wealth of experience,

1. "Interplanetary Man," in *An Olaf Stapledon Reader*, ed. **Robert Crossley** (Syracuse, N. Y., 1997), 218-241: 237-238.

through this 'commonwealth of worlds,' new levels of mental and spiritual development should become possible, levels at present quite inconceivable to man."[2] By "Interplanetary Humanity" Stapledon thus hoped for more than the mere spread of humanity through the solar system; he hoped for a species physically, mentally, and spiritually improved over terrestrial humanity, privileged with new insights. Such genetic improvement was a key concept of his later fiction.

Such was the main message of Stapledon's best-known essay. In a postscript, however, he noted that intelligence in other planetary systems was also possible, no matter how unlikely it was in our own system. Unaware of the developments in radio astronomy, begun with Karl Jansky in 1933 and being developed in 1948 by Grote Reber and a very few others, Stapledon conjectured that "communication with intelligent races in even the remotest planetary systems may be effected by a highly developed technique of telepathy." Though he was (as far as we know!) wrong about the technique, Stapledon was very much in the spirit of today's tradition when he wrote, "If, by one means or another, man does succeed in communicating with intelligent races in remote worlds, then the right aim will be to enter into mutual understanding and appreciation with them, for mutual enrichment and the further expression of the spirit. One can imagine some sort of cosmical community of worlds."

With the benefit of 50 more years in understanding of our universe, we can see that not only will at least parts of Stapledon's vision of interplanetary humanity likely be realized over the next centuries, but that over the next millennium *Homo sapiens* will almost certainly become *interstellar* humanity. This will occur in three stages, each one filled with more potential—and more danger—than its predecessor. At Level One we will have an increased awareness of our place in the universe by an increased understanding of cosmic evolution. This increased awareness is simply a matter of the advance of many branches of science, and is well underway at the end of the 20th century. At Level Two we will have contact with extraterrestrial intelligence, most likely in the form of remote radio contact rather than physical contact. We are now on the brink of determining whether such intelligence is rare or abundant in the universe; we have only begun to think about the consequences. At Level Three, humanity will travel to the stars, physically spreading into the universe a genome constructed over 3.8 billion years of evolution on Earth, and perhaps by that time also altered along Stapledonian lines.

In all stages of interstellar humanity, the questions of cosmic purpose and human destiny will be paramount. Our place in the scheme of cosmic evolution, the outcome of contact with extraterrestrials, and our ability to travel to the stars all bear strongly on the issue of our place in the universe and the ultimate fate of our species. Increased cosmic awareness, the exchange of information with extraterrestrials, and even the realization that intelligence is scarce as we physically expand into the galaxy will alter our religions, our philosophies, and the image of ourselves. Whether or not the "blind watchmaker" universe has an underlying purpose in cosmic evolution, whether our destiny is intertwined with alien sentient minds, and the nature of our long-term future are questions likely to be answered in the next millennium. All other questions pale in comparison.

Cosmic Evolution

At the end of the 20th century, more and more members of our species are increasingly aware of the new universe. At the beginning of the 20th century, respected scientists could still believe that our Sun was located at the center of our galaxy, and that this galaxy—with a diameter of some 3600 light years—comprised the entire universe. Today we know that the universe extends some 12 to 15 billion light-years, is populated with bizarre objects like pulsars, quasars, and black holes, and is an Einsteinian space-time continuum that has no center. The Hubble Space Telescope, peering into the very depths of this universe, finds billions of galaxies similar and dissimilar to our own. The Earth seems an insignificant speck in the vastness of space.

At the same time this new universe of immense space is not static, but evolving, and presumably has been evolving for as long as 15 billion years. Following in the wake of the Darwinian revolution, the idea of cosmic evolution was already glimpsed at the beginning of the 20th century, though the immensity of the time scale was not yet known. Percival Lowell's *The Evolution of Worlds* (1909) applied physical evolution to the solar system, while George Elery Hale's *The Study of Stellar Evolution* (1907) applied it to the stars. By 1929 Edwin Hubble gave an evolutionary dimension to the universe as a whole, by providing

2. *Ibid*., 238.

data on the recession rate of galaxies that showed the universe was expanding. Today the Big Bang cosmology is believed to provide the reason for that expansion, and the density of the universe appears to be such that the expansion will continue forever.[3]

But cosmic evolution applies to more than the physical universe. Harvard biochemist Lawrence J. Henderson not only grasped the essential idea of cosmic biological evolution in *The Fitness of the Environment* (1913), but also claimed a superior role for it: *The properties of matter and the course of cosmic evolution are now seen to be intimately related to the structure of the living being and to its activities; they become, therefore, far more important in biology than has been previously suspected. For the whole evolutionary process, both cosmic and organic, is one, and the biologist may now rightly regard the universe in its very essence as biocentric*. Volumes such as Harlow Shapley's *Of Stars and Men* (1958), Eric Chaisson's *Cosmic Dawn* (1981), and Carl Sagan's *Cosmos* (1980) spread the idea that human destiny may be understood only in the context of cosmic evolution.[4]

Today, cosmic biological evolution is the central assumption of NASA's Origins program, the touchstone for both astronomers and biologists, and the starting point for numerous science fiction writers. The worldview of cosmic evolutionists from Henderson to the present is epitomized by Nobel biochemist Christian de Duve, who in *Vital Dust: Life as a Cosmic Imperative* (1995) concluded that "the universe is not the inert cosmos of the physicist, with a little life added for good measure. The universe *is* life, with the necessary infrastructure around it; it consists foremost of trillions of biospheres generated and sustained by the rest of the universe."[5]

This "biological universe," as I have termed it elsewhere, is very different from a merely physical universe filled with lifeless planets, stars, and galaxies.[6] As the new universe and cosmic evolution pervade the consciousness of *Homo sapiens*, they hold different meanings for different groups. Cosmic consciousness is expressed in many forms, some of them unpalatable to most scientists: belief in UFOs and extraterrestrial abduction, space-oriented religious cults (such as Heaven's Gate) whose members sacrifice their lives to join the supposed aliens, and ever more elaborate (and often hostile) scenarios of science fiction. While this diversity should warn us that human reactions to the new universe will not be monolithic, it should not prevent us from recognizing undeniable underlying principles.

First, for all groups, the increased awareness of the new universe should dash any remaining hopes for an anthropocentric universe. Even though the idea that the universe was made for man survives in the form of the elegantly misnamed "anthropic principle," in fact that principle is (in Henderson's terms) a "biocentric principle" that points to the abundance of life in the universe in many forms, rather than in the form of man. If life, mind, and intelligence are the common outcomes of cosmic evolution, rather than simply planets, stars, and galaxies, then our religions, philosophies, and other human endeavors as currently formulated are too parochial. They will need to be significantly altered, expanded, or discarded in the coming millennium.

Secondly, quite apart from its nonanthropocentric consequences, cosmic evolution provides humanity a cosmic context in time. Our own planet is 4.5 billion years old; as we look into space we can now see solar systems only half a billion years old. Because of the finite speed of light, the more distant we look, the further back we are looking into our past, stretching back perhaps 15 billion years. But we are also looking into our future. Several generations of stars have already been born, lived, and died, and by peering into space we see their fate, and our fate. We know that in 1.1 billion years our Sun will become too hot for life on Earth, that in 7 billion years it will become a full-fledged *red giant* engulfing the Earth, and that a few hundred million years later it will settle down to the dead end of stellar evolution known as a *white dwarf*. Though we are not accustomed to thinking in such time scales, cosmic evolution defines the stage of the human drama and allows us to see the life of our species in perspective.

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3. **Percival Lowell**, *The Evolution of Worlds* (New York, 1909); **G. E. Hale**, *The Study of Stellar Evolution* (Chicago, 1907); 2; **Hubble**, *The Realm of the Nebulae* (New Haven, 1936). The latest ideas on the ultimate fate of an eternally expanding universe are found in **Fred C. Adams** and **Gregory Laughlin**, "The Future of the Universe," *Sky and Telescope*, 96 (August 1998), 32-39.

4. **L. J. Henderson**, *The Fitness of the Environment* (Cambridge, Mass., 1913), reprinted with an introduction by **George Wald** (Gloucester, Mass., 1979), p. 312; **Harlow Shapley**, *Of Stars and Men* (Boston, 1958); **Eric Chaisson**, *Cosmic Dawn* (Boston, 1981), **Carl Sagan**, *Cosmos* (New York, 1980).

5. **Christian de Duve**, *Vital Dust: Life as a Cosmic Imperative* (1995), 292-293.

6. **Steven J. Dick**, *The Biological Universe* (Cambridge, 1996), *Life on Other Worlds* (Cambridge, 1998).

Finally, cosmic evolution teaches us that we are all "star stuff," in Sagan's colorful terminology. All elements except hydrogen and helium, including the biogenic elements and those found inside our bodies, were forged deep within the stars. Over the next millennium, as new-generation space-based and ground-based telescopes carry out the "archaeology of the heavens," they will uncover our past and our future. Even as they confirm the immensity of the universe and its blindingly hostile nature compared to our fragile biosphere, our human star stuff makes humanity a part of the cosmos in the same way that Copernicus made the Earth part of the cosmos 500 years ago. With this knowledge we may begin to feel at home in the universe rather than estranged from it. We will increasingly understand it, to some extent control it, and perhaps have to share it, depending on whether or not life is abundant. In this context, much depends on the prevalence, nature, and motives of extraterrestrial intelligence.

Extraterrestrial Intelligence

Nothing could usher in a sustained interstellar humanity more forcefully or more quickly than contact with extraterrestrial intelligence. While the first half of the 20th century still held hope for interplanetary intelligence, even Stapledon realized—and we are now virtually certain—that if extraterrestrial intelligence exists, it will be found only among the planets of other stars. (Unless such intelligence or its artifacts find their way to our solar system.) The discoveries of possible Martian fossils, of Europan oceans, of the ancient origin of terrestrial life under adverse conditions, and of extremophile organisms on Earth today, all point to life as a probable common emergent property of the physical universe. At the same time the discovery of numerous planetary systems populated by gas giants, presumably accompanied by terrestrial planets, provides abundant potential life sites. Although the frequency of the evolution of intelligence is still problematic, electromagnetic SETI (Search for Extraterrestrial Intelligence) programs, if they are to succeed at all, will certainly succeed in the next thousand years. Alternative modes of contact are logically possible: Bracewell probes or Tough microprobes, a breakthrough in UFO studies, and the discovery of alien artifacts in the course of space exploration are possibilities that cannot be ruled out.[7]

The consequences of the discovery of extraterrestrial intelligence in the next millennium depend strongly on the contact scenario. But we need not surrender because of this uncertainty; at least three approaches are possible in studying such contact. The first is the imagination, as exemplified in alien science fiction literature, which lays out the possibilities. The effect of the physical presence of extraterrestrials on Earth in the mode of Arthur C. Clarke's *Childhood's End* (1953) is very different from the discovery of an alien artifact, as played out in Clarke's *Rendezvous with Rama* (1973) and its sequels. Both are again very different from scenarios of radio contact, as examined in James Gunn's *The Listeners* (1972) and Carl Sagan's *Contact* (1985). And all these scenarios are far removed from the vision of Fred Hoyle's *Black Cloud* (1957), where the intelligence is nonhumanoid, or Stanislaw Lem's *Solaris* (1961), where the alien intelligence remains mysterious and incomprehensible. Science fiction literature (some more elegantly than others) provides a rich source of thoughtful commentary on the consequences of extraterrestrial contact. Though there is an overemphasis on alien invaders in the mode of H. G. Wells's *War of the Worlds* (1898), we do not in fact know which of the logical possibilities we will find in reality. In its more sublime creations, witnessed in Mary Doria Russell's *The Sparrow* (1996), science fiction sheds light on religion and morality. The imaginations of science fiction writers demonstrate the possibilities; science must discover the realities.

A second approach is grounded in the data of human experience and history. We may demonstrate this by taking the case of radio contact. Contrary to popular wisdom, radio contact with extraterrestrials—the object of SETI programs—will not be analogous to the physical contact of cultures on Earth. As has often been pointed out, physical culture contacts on Earth have most often been disastrous: witness Cortes and the Aztecs, or Pizarro and the Incas, or any number of other culture contacts. Rather, radio contact is analogous to intellectual culture contacts on Earth. Particularly apt is the analogy to the transmission of Greek knowledge to the Latin West via the Arabs in the 12th and 13th centuries. The result was the Renaissance. Moreover, because contact among extraterrestrial civilizations is fundamentally delayed by the finite speed of light in direct proportion to the

7. On Bracewell probes, see **Ronald Bracewell**, *The Galactic Club* (San Francisco, 1975), 69-83. On Tough microprobes see **Allen Tough**, "Small Smart Interstellar Probes," *Journal of the British Interplanetary Society*, 51 (May 1998), 167-174.

intervening distance, like the Greek and European civilizations, communications must take place across time. It is even possible the extraterrestrial civilization will be extinct by the time its signal reaches Earth, as the Greek civilization had reached its peak long before its knowledge was transmitted to the Latin West.[8]

If the decoding of an extraterrestrial message results in a vast amount of knowledge, these analogies might break down. But a case can be made that deciphering a message could be a slow process, perhaps continuing over generations, and thus more analogous to the translation of Greek knowledge. While both positive and negative analogies may be usefully applied, the nature of the message is the all-important unknown factor. Because of the age of the universe, however, extraterrestrial civilizations are likely to be much older than we are, perhaps, it has been conjectured, holding the knowledge of the universe in an *Encyclopedia Galactica*. By making contact we may become part of a Galactic Club—Stapledon's cosmical community of worlds.

In a more general sense, we may use the trajectory of worldviews as an analogy for extraterrestrial contact. The belief in "the biological universe"—one in which cosmic evolution commonly ends in life and intelligence—is a kind of worldview similar in status to the Copernican worldview or the Darwinian worldview. Like them, the biological universe as worldview strongly affects humanity's place in the universe. Like them, it is testable locally via spacecraft and globally via SETI programs. And like them, it will go through certain stages of interpretation and explorations of implications. The rich literature in the history of science examining these revolutions may therefore be used cautiously to examine the implications of the biological universe.[9]

The third mode of examining the effect of extraterrestrial intelligence is social science. Albert Harrison's recent book, *After Contact: The Human Response to Extraterrestrial Life* (1997), has led the way in showing how fields such as psychology, sociology, and anthropology can be used as an aid to thinking about implications of contact. In particular he advocates a kind of systems approach, called Living Systems Theory, in which what we know about organisms, societies, and supranational systems on Earth can be used to discuss the outer space analogues of extraterrestrials, extraterrestrial civilizations, and the Galactic Club. This is a promising approach to the study of implications, though Harrison applies it only to aliens and civilizations, not to low life-forms and Martian nanofossils. The latter entails a shift in worldview quite distinct from communicative extraterrestrials, a difference that Living Systems Theory may also illuminate.[10]

The exchange of ideas likely in the radio contact scenario is not the only possibility. Other contact scenarios—physical contact, or contact by probes or microprobes with varying capabilities—have their own analogues in history. No historical analogues will be perfect, but they provide a starting point and lay out options, and the very discussion of why they are not perfect will be illuminating.

Science fiction, terrestrial analogues in human history, and Living Systems Theory are three fundamentally different ways to gauge the impact of extraterrestrial contact. All, it is true, make use of our terrestrial experience. But it is difficult to transcend that experience until contact is actually made. In any case, a systematic study using these three approaches promises to shed considerable light on our future over the next millennium. While the nature of the knowledge gained from extraterrestrial contact remains a wildcard, these approaches can nevertheless give us an outline of possible impacts. Whatever the impact, we may predict that the exchange of information will shed light on the great problems of philosophy; if communication can be achieved, for example, the problem of objective knowledge will be raised to a new level of sophistication as the communicating intelligences share their knowledge. It is hard to imagine any event in the next millennium that could have greater consequences for human life and the future of our planet.

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8. **Steven J. Dick**, "Consequences of Success in SETI: Lessons from the History of Science," and **Ivan Almar**, "The Consequences of a Discovery: Different Scenarios," in *Progress in the Search for Extraterrestrial Life*, ed. **G. Seth Shostak** (San Francisco, 1995), pp. 521-532 and 499-505.

9. **Steven J. Dick**, "Consequences of Success," (note 8); *The Biological Universe*, Cambridge, 1996; "From the Physical World to the Biological Universe," in *Bioastronomy: The Search for Extraterrestrial Life*, eds. **J. Heidmann** and **M. J. Klein** (Berlin, 1991), 356-363.

10. **Albert Harrison**, *After Contact: The Human Response to Extraterrestrial Life* (1997). For other considerations of contact see Paul Davies, *Are We Alone? Philosophical Implications of Discovery of Extraterrestrial Intelligence* (New York, 1995).

Interstellar Travel

Although some believe that interstellar travel is physically impossible because of distance and power requirements, history is not on the side of the pessimists. It is likely that their pessimism falls into the category of what Arthur C. Clarke has termed "failure of imagination," and that ways will be found to cross the ocean of space no less than the ingenuity of our predecessors carried them across the oceans of Earth. Indeed, the first full engineering study for an interstellar starship was published under the auspices of the British Interplanetary Society in 1978, 30 years after Stapledon's lecture. That vehicle was designed to travel to Barnard's star, at six light-years one of the closest stars to our Sun. A feel for even nearby interstellar distances may be glimpsed by realizing that at a cruising speed 12 percent the speed of light, such a starship would take 50 years. The propulsion system was based on nuclear fusion and required mining the helium-rich atmosphere of Jupiter to propel the 450-ton payload. Even then this was a flyby mission; no fuel would remain for deceleration from 12 percent the speed of light.[11]

Clearly interstellar travel will challenge humanity, and many practical problems await solution. When we consider where human transportation technology was a thousand years ago, it is probable that over the next millennium propulsion systems such as the matter-antimatter drive, star sails, or those based on concepts as yet unglimpsed will lead humanity to the stars. Indeed, given the distances and times involved, one technology is likely to leapfrog another, and early-generation starships literally surpassed on their way to the stars.

Whatever the case, interstellar travel will be the capstone to interstellar humanity. Daunting as the task seems, someday the hundreds of billions of stars in our own galaxy will have been explored, and the nearby galaxies will beckon. We may safely predict, however, that the era of intergalactic humanity will not take place in the next millennium. At the speed of light, it would take a half-million light-years to reach the nearest galaxy. Unless, that is, one is transported to distant regions of the universe via wormholes associated with black holes. But this, too, is unlikely in the next millennium. Humanity is likely to be preoccupied over the next millennium with roving our own galaxy, with its 100,000 light-year diameter. Even at the end of the next millennium, humanity will still have limits.[12]

We may well wonder, if extraterrestrials are abundant and interstellar travel is common, why interstellar starships are not evident in the vicinity of Earth. This paradox, first posed by Enrico Fermi 50 years ago, asserts that given the long time scale of the universe, if extraterrestrials are abundant, they should have colonized the galaxy within a few million years and arrived on Earth long ago. Since we do not see them (barring arguments for the extraterrestrial hypothesis of UFOs), skeptics of the biological universe assert they do not exist. This argument has led SETI proponents to assert that interstellar travel is not economical, not the most efficient mode of interstellar contact, or not an interest of most civilizations. However, only one civilization is required to give force to the paradox. Conversely, only one need be discovered by SETI programs or interstellar travel to find the solution to the Fermi Paradox.

Quite aside from any merits of the Fermi Paradox, human interstellar travel over the next millennium will likely proceed. History shows that exploration is an essential part of the human imperative, and while for economic and other reasons robot probes may precede human exploration, even the brief history of interplanetary exploration indicates that human exploration will follow. The Pioneer 10 and 11 and Voyager 1 and 2 spacecraft, vestiges of interplanetary humanity, are our species' first emissaries to the stars, complete with messages for any extraterrestrials who chance to intercept them. At .005 percent the speed of light, the Voyagers will take 80,000 years to reach the distance of the nearest star, Alpha Centauri.

We should recognize that it is possible—though we believe not probable, in light of what we now know about cosmic evolution—that *Homo sapiens* is the only intelligent species in the galaxy. There is precedent for this too in science fiction; perhaps its most famous story, Isaac Asimov's *Foundation* series, is carried out in a galaxy devoid of extraterrestrials but colonized by man. One can hardly say that it is a less interesting universe; the preservation of knowledge is its centerpiece, and the *Encyclopedia Galactica* its

11. *Project Daedalus—The Final Report on the BIS Starship Study*, ed. **A. R. Martin**, *Journal of the British Interplanetary Society*, Supplement (1978).

12. On interstellar travel see **I. A. Crawford**, "Interstellar Travel: A Review for Astronomers," 31, *Quarterly Journal of the Royal Astronomical Society* (1990), 377-400. On the wormhole concept and its history see **Paul Halpern**, *Cosmic Wormholes: The Search for Interstellar Shortcuts* (New York, 1992).

anchor. The *Encyclopedia Galactica* is also a frequent theme of universes populated with extraterrestrials, now containing all the knowledge of the Galactic Club. In either case, the era of interstellar humanity will not be "the end of history" or "the end of science" in the rather parochial view of Earthbound humanity posited at the end of the second millennium.[13]

With interstellar travel the human genome will physically be transported into space. Moreover, it is likely that the long distances required in interstellar travel will drive human intervention in that genome, so that humans, or their successor species, will be engineered to withstand the rigors of the trip. Even if traditional ideas like suspended animation prove practical, genetic considerations are likely to play an important role in maximizing efficiency and success. What effect an extraterrestrial genome might have on us it is too soon to say, but natural selection on distant planets may have developed more efficient models of intelligence than ours; at the pace of genetic intervention today, it is likely that over the next millennium our species will wish to make use of alien genetics, quite aside from its own. The principles of human ethics and morality will continue to be tested.

Finally, even as interstellar travel proceeds, Asimov and others remind us that new sciences will arise and old ones will sprout new directions as yet unseen. "Psychohistory"—the statistical treatment of historical trends to predict future outcomes—plays a major role in the *Foundation* novels. The social sciences may come into their own in the next millennium, and brain sciences almost certainly will. Moreover, technologies such as robotic intelligence and nanotechnology will be developed. These new sciences and technologies will feed into the future in ways now intrinsically unforeseeable. But they will change only the details, not the fact, of interstellar humanity.

What are the consequences of interstellar travel? A glimpse of the struggles that interstellar travelers will face may be seen in Finney and Jones's *Interstellar Migration and the Human Experience*.[14] Again, it is based on analogy, with European exploration, Polynesian expansion across the Pacific, and the stillborn attempts of other societies at colonization. For those who succeed, we may predict only in the most general terms that interstellar humanity will be highly dependent on technology, still struggling with the same problems of human nature that we face today, but will operate in a vastly expanded domain that incorporates a full knowledge of cosmic evolution and may involve interstellar politics in which the principals are extraterrestrial civilizations. Unlike radio contact, physical contact with extraterrestrial intelligence forces us to consider the negative analogies of physical culture contact on Earth. If we can survive such contact, the deepest questions of the species, pondered since our earliest human ancestors looked skyward and wondered about the stars, will be answered. Stapledon's fondest wish may be realized in interstellar humanity rather than interplanetary man.

Cosmic Destiny

In the era of interstellar humanity, the fundamental questions of the species are likely to remain the same as today. Foremost among them are the questions of cosmic purpose and human destiny, issues that were raised in the 20th century in the context of the new biology and the new astronomy, which find their intersection in the discipline variously termed *bioastronomy*, *exobiology*, and *astrobiology*—the study of the biological universe.

Almost at the same time Stapledon wrote his essay on "Interplanetary Man?" the French scientist LeComte du Nouy wrote a widely hailed volume entitled *Human Destiny* (1947). There he concluded that the simple protein molecule would have taken 243 orders of magnitude more time than the age of the Earth to form by chance, that life itself could therefore not have arisen by chance, and that "these consequences inevitably lead to the idea of God." The same theme pervaded the influential book *Chance and Necessity* (1971) of the French biologist Jacques Monod when he wrote, after long thought on the consequences of his own discoveries, "The universe was not pregnant with life, nor the biosphere with man. Our number came up in the Monte Carlo game."[15]

It was this kind of universe that led to pessimistic ideas of cosmic purpose and human destiny. Nobel

13. **Francis Fukuyama**, *The End of History and the Last Man* (New York, 1992); **John Horgan**, *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age* (Reading, Mass., 1996).

14. *Interstellar Migration and the Human Experience,* ed. **Ben R. Finney** and **Eric M. Jones** (Berkeley, 1985).

15.**LeComte du Nouy**, *Human Destiny* (New York, 1947); **Jacques Monod**, *Chance and Necessity* (New York, 1971), 144-146.

physicist Steven Weinberg, for example, wrote, "It is almost irresistible for humans to believe that we have some special relation to the universe, that human life is not just a more-or-less farcical outcome of a chain of accidents reaching back to the first three minutes, but that we were somehow built in from the beginning…. It is very hard to believe that all this is just a tiny part of an overwhelmingly hostile universe. It is even harder to realize that this present universe has evolved from an unspeakable unfamiliar early condition, and faces a future extinction of endless cold or intolerable heat. The more the universe seems comprehensible, the more it also seems pointless."[16]

But this conclusion did not take into account the biological universe, nor did it consider unexpected developments in the fields of chaos and complexity. In particular, Stuart Kauffman and others have pioneered the idea of self-organization; in his book *At Home in the Universe* Kauffman has detailed how life could have originated by the natural tendency of matter to self-organize. Under this scenario, Nobel biochemist Christian de Duve could write, "I view this universe not as a cosmic joke, but as a meaningful entity—made in such a way to generate life and mind, bound to give birth to living beings able to discern truth, apprehend beauty, feel love, yearn after goodness, define evil, experience mystery."[17] This is the view championed by many cosmic evolution pioneers, including Carl Sagan. The whole scenario of cosmic biological evolution, not taken into account by du Nouy, Monod, or Weinberg, potentially places human life in a new context in terms of purpose and destiny. It is just such questions that coincide with the Stapledonian wish to use new worlds to advance the human spirit; those are the questions of ultimate importance to interstellar humanity.

Human destiny very much depends on the course of cosmic evolution. With Stapledon, we may conclude that it will be very different if the galaxy is inhabited, or if it is not. If it is, then we may join the Galactic Club, have access (and perhaps even add) to the *Encyclopedia Galactica*. If it is not inhabited, then it is our destiny to fill the galaxy with life; the *Encyclopedia Galactica* will be the history of the human race, or its genetic or robotic descendants. In the latter case, interstellar migration and colonization are our future; interstellar travel, rather than extraterrestrial intelligence, will predominate interstellar humanity. In that case, the Fermi Paradox will have proven its force, though the search for life will likely go on as an important part of the exploration imperative.

Conclusion

Cosmic evolution, extraterrestrial intelligence, and interstellar travel will shape interstellar humanity in the next millennium. Those who take part directly in these ventures will certainly be affected, but so also will much of humanity. Consciousness of cosmic evolution is increasing and will continue to increase because of a fundamental human desire to answer the question that more than 130 years ago T. H. Huxley called "the question of questions for mankind—the problem which underlies all others and is more deeply interesting than any other," humanity's place in nature.[18] Huxley was speaking in the context of Darwinian theory of evolution by natural selection; that question has now been extended to cosmic evolution, and therefore the problem of our place in the universe.

The search for extraterrestrial life is an essential part of that problem. Whereas Kepler, Galileo, Newton, and their modern-day successors demonstrated the role of physical law in the universe, the question at stake in the extraterrestrial life debate is whether an analogous "biological law" reigns throughout the universe, whether Darwinian natural selection is a universal phenomenon rather than simply a terrestrial one, whether there are other biologies, histories, religions, and philosophies beyond the Earth. In short, at stake is whether *Homo sapiens* inhabits a physical, or a biological, universe. The two yield fundamentally different worldviews. During the next millennium, probably earlier rather than later, we will likely discover which is true. The rest of the millennium will be spent in exploring the implications of this profound truth.

Looking back from the year 3000—some 40 generations hence—most of the historical and political issues that concern us now will have been forgotten. World War II will seem as distant as the Battle of Hastings does to us now. The geopolitical landscape will have transformed into an astropolitical landscape. Our science will seem quaint and embryonic.

16. **Steven Weinberg**, *The First Three Minutes* (New York, 1977), 154.

17. **Christian de Duve**, *Vital Dust* (New York, 1995), xviii; **Stuart Kauffman**, *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity* (New York and Oxford, 1995).

18. **T. H. Huxley**, *Man's Place in Nature* (1863; Ann Arbor, Mich., 1971 ed.), 71.

But the desire to know better our place in the universe, to push the frontiers, to explore beyond one more barrier, will remain.

A final cautionary note is in order. The question mark in Stapledon's title referred not only to the accuracy of his prediction, but also to the survival of civilization in the new atomic age. Even in our age, we must still allow for the possibility that the hopes for interplanetary and interstellar man will be dashed by the follies of adolescent humanity, and that a thousand years from now some extraterrestrial archaeological expedition will be picking through the remains of terrestrial man, whose follies exceeded its promise and cut short its brief history. As with the atomic age, the age of genetic engineering and other scientific advances yet unseen will each bring danger as well as opportunity. Even though the destruction of *Homo sapiens* might constitute only a blip in the scheme of cosmic evolution (depending on the prevalence of intelligence elsewhere), as individuals each of us must do what he or she can to see that this future does not prevail.

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