

*First published in , The Great Frontier has become one of the undisputed classics of Western history, its conclusions still hotly debated by scholars but nonetheless essential and engrossing reading for anyone who wishes to understand the history and significance of this vast and often puzzling region.*

Gene Regulation Gene Control: Transcription Factors and Mechanisms Since the elucidation of the double-helix structure of deoxyribonucleic acid DNA in , biologists have been racing to understand the details of the science of genetics. The deeper they penetrate into the workings of the DNA process, however, the more complexity emerges, challenging the early optimism that characterizing the structural mechanisms would reveal the entire picture. It now appears likely that life within an organism unfolds as a dynamic process, guided by the DNA program to be sure, yet not subject to clockwork predictability. One of the most intriguing questions involves the very first step in the process, how the DNA itself delivers its information to the organism. Eric Lander of the Whitehead Institute at the Massachusetts Institute of Technology organized the session "to give a coordinated picture of gene control in its many different manifestations, both the different biological problems to which it applies and the different methods people use for understanding it. Transcription Factors and Mechanisms. Science at the Frontier. The National Academies Press. The field of molecular biology has exploded into the forefront of the life sciences, and as its practitioners rapidly develop applications from these insights, new horizons appear continuously. The working elements of genetics, called genes, can now be duplicated and manufactured, and then reintroduced into living organisms, which generally accept them and follow their new instructions. A summary of what has been learned about DNA might serve as a useful introduction to the discussion on transcription and gene expression: The heritable genetic information for all life comes in the form of a molecule called DNA. Intrinsic to the structure of the DNA molecule are very long strings composed of so-called base pairs, of which there are four types. A gene is a segment of this string that has a particular sequence of the four base pairs, giving it a unique character. Genes are linked one after another, and the string of DNA is carried on complex structures called chromosomes, of which there are 23 pairs in humans. Researchers put the number of discrete genes in humans at about , To clarify the concept of DNA, Douglas Hanahan from the University of California, San Francisco, invoked the metaphor of a magnetic tape, "which looks the same throughout, but has within it or can have discrete songs composed of information. The general outline of this picture was known by the early s, but even the electron microscope had not revealed exactly how the DNA molecule was structured. When British biophysicist Francis Crick and American molecular biologist James Watson first proposed the double-helix structure for DNA, a thunderclap echoed throughout molecular biology and biochemistry. The structure of DNA was at once realized to be dramatically suggestive of how the molecule actually functions to store and deliver coded information. By weak chemical bonding between complementary basesâ€”adenine with thymine and cytosine with guanine, and each pair vice versaâ€”the hereditary store of information in all life forms takes shape as a coded sequence of simple signals. The signals are arranged in the double-helix structure discovered by Watson and Crick. Picture two strands of rope side by side, each with a string of chemical bases along its length Figure 5. When a base on the first rope is adenine A , the base opposite it on the other rope Figure 5. The structure repeats at intervals of 34 angstroms, which corresponds to 10 residues on each chain. Reprinted by permission from W. Page 97 Share Cite Suggested Citation: Also conversely, if thymine appears on one strand, adenine will be found opposite on the other strand. The same logic applies to analogous pairings with cytosine C and guanine G. These base pairs present the horizontal connection, as it were, by their affinity for a weak chemical bond with their complementary partner on the opposite strand. Thus the ropeâ€”call it a single strand, either the sense strand or the antisense strandâ€”of DNA can have virtually any sequence of A, C, G, and T. The other strand will necessarily have the complementary sequence. The code is simply the sequence of base pairs, usually approached by looking at one of the strands only. In their quest to explain the complexity of life, scientists next turned to deciphering the code. Once it was realized that the four nucleotide bases were the basic letters of the genetic alphabet, the question became, How do they form the words? The answer was

known within a decade: Fitting the 64 "word commands" to the 20 outcomes showed that a number of the amino acids could be commanded by more than one three-letter "word sequence," or nucleotide triplet, known as a codon Figure 5. The explanation remains an interesting question, and so far the best guess seems to be the redundancy-as-error-protection theory: The vehicle for the transmission of information is RNA. Once the messenger transcript is made, its translation eventually results in the production polymerization of a series of amino acids that are strung together with peptide bonds into long, linear chains that in turn fold into interesting, often globular molecular shapes due to weak chemical affinities between and among various amino acids. Page 98 Share Cite Suggested Citation: Several ribosomes may be attached to one mRNA molecule at one time; the entire assembly is called a polyribosome. B Transcription and translation. Each group of three is a codon that is complementary to a group of three nucleotides in the anti-codon region of a specific transfer tRNA molecule. When base pairing occurs, an amino acid carried at the other end of the tRNA molecule is added to the growing protein chain. Reprinted with permission from Watson et al. Page 99 Share Cite Suggested Citation: Transcription Factors and Mechanisms," touched on much of the above background and presented some of the basic issues scientists are exploring as they probe the mRNA process. His colleagues in the session on gene regulation each described intriguing findings based on their studies of regulation in various organisms: They explained their work to the symposium and suggested how its implications may help to clarify human genetics and fill in the larger picture of how life operates. Scientists cannot say for certain whether the majority of noncoding genes that do not seem to say simply "make this string of amino acids," are saying anything at all. Tjian has heard a lot of speculation on this question: But far be it for me to say that all that intervening sequence is entirely unimportant. Why do amphibians have so much more DNA than we do? Actually, a lot of people wonder about whether those sequences are perhaps there for more subtle differences—differences between you and me that at our present stage of sophistication may be too difficult to discern. How would you get rid of it? It takes work by way of natural selection to get rid of things, and if it is not a problem, why would you junk it? That is really the way life is probably looking at it. Or more likely, a number of functions. Now that the questions being posed by scientists mapping the genome are starting to become more refined and subtle, the very definition of a gene is starting to wobble. It is often convenient to conceptualize genes as a string of discrete pearls—or an intertwined string following the double-helix metaphor—that are collected on a given chromosome. But Tjian reinforces the significance of the discovery that much less than half of the base sequences are actually coding for the creation of a protein. He is searching for the messages contained in the larger by a factor of three or four "noncoding" portion of the human genome. Mapping is one thing: For Tjian, however, that will only be like the gathering of a big pile of puzzle pieces. He is looking to the next stage, trying to put the puzzle together, but from this early point in the process it is difficult to say for certain even what the size and shape of the individual pieces look like. He knows the title of the assembled picture: Life is a process, calling for infinitely many and infinitely subtle reactions and responses to the conditions that unfold. The formal way of clarifying this is to refer to the actual generic sequence of bases in an organism as its genotype, and the actual physical life form that genotype evolves into as the phenotype. Tjian and his colleagues strongly suspect that, on the cellular level—which is the level where molecular biologists quest and where DNA eventually produces its effects—the instructions are not merely laid down and then run out like a permanently and deterministically wound-up clock. Most of the noninstinctive—that is, other than biochemically exigent and predictable—functions performed within the cell must have a guiding intelligence, and that intelligence must be coded in the DNA. The Central Dogma of Biology Not long after Crick and Watson made their celebrated discovery, they pursued their separate researches, and Crick was among those given the most credit for helping to unravel the code itself. Crick was responsible for what came to be called the central dogma of biology—the sequence of steps involved in the flow of information from the DNA master plan through to the final manufacture of the proteins that power the life process Figure 5. Molecular biologists and biochemists have uncovered a number of fascinating and unexpected phenomena at each of these distinct steps. But the transcript made at the first step is understandably critical, because somehow the proper part of the enormous DNA master plan—the correct gene or sequence of genes—must be accessed, consulted, and translated for transmission to the next step. A

cell has many jobs to do and seems to be programmed to do them. Moreover, the cell must react to its environment and thus is constantly sensing phenomena at its cell membrane with receptors designed for the task, and then transmitting a chemically coded signal to the nucleus. Processing this information, to continue the metaphor, requires a software program, and undoubtedly the program is located in the genes. It is the job of the transcription machinery to find the proper part of the genome where the needed information is located. The arrows indicate the directions proposed for the transfer of genetic information. Correspondingly, all proteins are determined by "translated on" RNA templates. Most importantly, the last two arrows were presented as unidirectional; that is, RNA sequences are never determined by protein templates, nor was DNA then imagined ever to be made on RNA templates. Bottom Transcription and translation are closely coupled in procaryotes A , whereas they are spatially and temporally separate in eucaryotes B. In procaryotes, the primary transcript serves as mRNA and is used immediately as the template for protein synthesis. In eucaryotes, mRNA precursors are processed and spliced in the nucleus before being transported to the cytosol. Page Share Cite Suggested Citation: One could be thought of as preprogrammed; for example, when a cell begins to die its natural death, it must be replaced, and a full new set of DNA must be created for the progeny cell. Such a DNA replication event is biologically predictable, and thus it could conceivably be anticipated within the program itself. But a different sort of signal is probably far the more numerous sort: With this latter sort of signal, the RNA-transcribing enzyme, RNA polymerase, is somehow able to search out the proper part of the DNA library where the needed information is stored, copy it down by transcription, and then deliver the transcript to the next step in the process, which will move it outside the nucleus to the ribosomes. Again, the central dogma. Since the chemical rules by which RNA polymerase operates are fairly well understood, he is looking for more subtle answers, related to how the protein finds the proper part or parts of the genome—that is, the gene or genes that need to be consulted at the moment. His research indicates that the answer most likely will involve at least several phenomena, but his target at the moment is a collection of proteins called transcription factors. Since timing is also a crucial component of the transcription process, geneticists are trying to understand how the rapid-fire creation of proteins is coordinated: This long string, when conceived as the product of a program, can be seen as the sequential order in which the proteins are called for and assembled, because they are strung together one after another by chemical bonding in a long chain in one direction only. The ribosomal cell factories pump out proteins at the rate of over 30 per second. An only slightly fanciful example: Thanks to the electron microscope, Tjian was able to provide moving pictures of the transcription process in action.

**Chapter 2 : An Explorer on the Frontier of Behavior | Biological Sciences**

*The frontier factor in modern history --The emergence of the individual --The recrystallization of society --The parabola of individualism --The genesis of modern dynamism --Frontier windfalls and modern capitalism --Three unwise bubbles --The frontier as a modifier of institutions --The fallacy of new frontiers --What the frontier touched: the.*

April 26, 2013 Up for a hands-on game challenge? Navigate a flying quadcopter during stormy Alaska weather, catch the perfect aerial shot of rare wildlife, and uncover trails through rough sea ice, all in the new mobile app game Arctic UAVs. Unmanned aerial vehicles are high-tech flying technological tools. UAVs are on the cutting edge of science. To explore more, use the game to link to real UAV science online. I think anyone with a bit of patience and willingness to learn can enjoy the game. It offers educational benefits, but they certainly do not take away from the fun. Scientists in Alaska are using UAVs to explore new research approaches. Have fun flying your copter and see levels showing off groundbreaking science as you progress through the game. Related Frontier Scientists videos reveal the real science. You are on a boat offshore from the Aleutian Islands, Alaska. Seas are rough, with high waves and 25 mph winds blowing rain sideways. During this mission, navigate your UAV quadcopter back to the boat and into the hand of the quadcopter catcher on deck ready and waiting. Fly Scout Fly Mission 2: Camera-shy sea otters need to be counted. Fly your UAV quadcopter over feeding otters at optimal height and capture photos without disturbing the otters or any other wildlife in their habitat. UAV over Otters Mission 3: Trails must be plotted in optimal locations to protect whaling crews in case the sea ice fractures and breaks loose from shore. Use aerial views to form sea ice terrain maps that can help locals plan out sea ice trails. Jonathan Newell is a computer science student working as a research project assistant with Research Computing Systems within the Geophysical Institute at University of Alaska Fairbanks. He is a developer for Arctic UAVs, a mobile app game. Jonathan enjoys spending his time with his family, watching movies and playing with his 1-year-old daughter. David Freeman has operated his graphic design business, Freeman Design, in Anchorage, Alaska since 2005. Specializing in identity and publication design, Mr. Freeman has designed a number of books for the University of Alaska Anchorage, publications for Alaska Native organizations and identity projects for small businesses throughout Alaska. Randy Titchenal is from Anchorage, Alaska, and has been working in the design field on identity branding, merchandising, collateral and direct marketing for both Fortune companies and design agencies in the Bay area for over 20 years. He has provided art direction, illustration and motion graphics and is also currently painting and printmaking out of his studio in the Mission arts district in San Francisco, California. Beyond work she enjoys making artist books, metalsmithing and jewelry making, trail running, and living off the grid.

**Chapter 3 : Fruit fly crowds touch-and-tell | Human Frontier Science Program**

*Frontier medicine, for the most part, studies alleged energies, fields, forces, or powers that can't be detected by modern science or technology. In other words, frontier medicine is not about medicine on the frontier but about medicine at the edges of the hinterlands where magical thinking is dominant.*

Daniel Boone escorting settlers through the Cumberland Gap In the colonial era, before , the west was of high priority for settlers and politicians. The American frontier began when Jamestown , Virginia was settled by the English in . In the earliest days of European settlement of the Atlantic coast, until about , the frontier was essentially any part of the interior of the continent beyond the fringe of existing settlements along the Atlantic coast. Only a few thousand French migrated to Canada; these habitants settled in villages along the St. Lawrence River , building communities that remained stable for long stretches; they did not simply jump west the way the British did. Although French fur traders ranged widely through the Great Lakes and mid-west region they seldom settled down. French settlement was limited to a few very small villages such as Kaskaskia, Illinois [8] as well as a larger settlement around New Orleans. Likewise, the Dutch set up fur trading posts in the Hudson River valley, followed by large grants of land to rich landowning patroons who brought in tenant farmers who created compact, permanent villages. They created a dense rural settlement in upstate New York, but they did not push westward. These areas remained primarily in subsistence agriculture, and as a result by the s these societies were highly egalitarian, as explained by historian Jackson Turner Main: The typical frontier society therefore was one in which class distinctions were minimized. The wealthy speculator, if one was involved, usually remained at home, so that ordinarily no one of wealth was a resident. The class of landless poor was small. The great majority were landowners, most of whom were also poor because they were starting with little property and had not yet cleared much land nor had they acquired the farm tools and animals which would one day make them prosperous. Few artisans settled on the frontier except for those who practiced a trade to supplement their primary occupation of farming. There might be a storekeeper, a minister, and perhaps a doctor; and there were a number of landless laborers. All the rest were farmers. North Carolina was representative. However frontier areas of that had good river connections were increasingly transformed into plantation agriculture. Rich men came in, bought up the good land, and worked it with slaves. The area was no longer "frontier". It had a stratified society comprising a powerful upper-class white landowning gentry, a small middle-class, a fairly large group of landless or tenant white farmers, and a growing slave population at the bottom of the social pyramid. Unlike the North, where small towns and even cities were common, the South was overwhelmingly rural. Land ownership brought a degree of independence as well as a vote for local and provincial offices. The typical New England settlements were quite compact and small—under a square mile. Conflict with the Native Americans arose out of political issues, namely who would rule. In the peace treaty of , France lost practically everything, as the lands west of the Mississippi river, in addition to Florida and New Orleans, went to Spain. Otherwise lands east of the Mississippi River and what is now Canada went to Britain. Steady migration to frontier lands[ edit ] Regardless of wars Americans were moving across the Appalachians into western Pennsylvania, what is now West Virginia, and areas of the Ohio Country , Kentucky and Tennessee. West of the mountains, settlements were curtailed briefly by a decree by the Royal Proclamation of . However the Treaty of Fort Stanwix re-opened most of the western lands for frontiersmen to settle. Pioneers housed themselves in a rough lean-to or at most a one-room log cabin. The main food supply at first came from hunting deer, turkeys, and other abundant game. Clad in typical frontier garb, leather breeches, moccasins, fur cap, and hunting shirt, and girded by a belt from which hung a hunting knife and a shot pouch—“all homemade”—the pioneer presented a unique appearance. In a short time he opened in the woods a patch, or clearing, on which he grew corn, wheat, flax, tobacco, and other products, even fruit. Homespun clothing replaced the animal skins. Land policy[ edit ] The land policy of the new nation was conservative, paying special attention to the needs of the settled East. By the s, however, the West was filling up with squatters who had no legal deed, although they may have paid money to previous settlers. The Jacksonian Democrats favored the squatters by promising rapid access to cheap land. By contrast, Henry Clay

was alarmed at the "lawless rabble" heading West who were undermining the utopian concept of a law-abiding, stable middle-class republican community. Rich southerners, meanwhile, looked for opportunities to buy high-quality land to set up slave plantations. The Free Soil movement of the s called for low-cost land for free white farmers, a position enacted into law by the new Republican Party in , offering free acre 65 ha homesteads to all adults, male and female, black and white, native-born or immigrant. Map of the Wilderness Road by After winning the Revolutionary War , American settlers in large numbers poured into the west. In , American pioneers to the Northwest Territory established Marietta, Ohio as the first permanent American settlement in the Northwest Territory. It was later lengthened to reach the Falls of the Ohio at Louisville. The Wilderness Road was steep and rough, and it could only be traversed on foot or horseback, but it was the best route for thousands of settlers moving into Kentucky. In alone, Indians killed over travelers on the Wilderness Road. No Indians lived permanently in Kentucky [24] but they sent raiding parties to stop the newcomers. Johnson , who later became Vice president The War of marked the final confrontation between major Indian forces trying to stop the advance, with British aid. The British war goal included the creation of an independent Indian state under British auspices in the Midwest. The death in battle of the Indian leader Tecumseh dissolved the coalition of hostile Indian tribes. In general the frontiersmen battled the Indians with little help from the U. Army or the federal government. They rejected the British plan to set up an Indian state in U. They explained the American policy toward acquisition of Indian lands: The United States, while intending never to acquire lands from the Indians otherwise than peaceably, and with their free consent, are fully determined, in that manner, progressively, and in proportion as their growing population may require, to reclaim from the state of nature, and to bring into cultivation every portion of the territory contained within their acknowledged boundaries. In thus providing for the support of millions of civilized beings, they will not violate any dictate of justice or of humanity; for they will not only give to the few thousand savages scattered over that territory an ample equivalent for any right they may surrender, but will always leave them the possession of lands more than they can cultivate, and more than adequate to their subsistence, comfort, and enjoyment, by cultivation. If this be a spirit of aggrandizement, the undersigned are prepared to admit, in that sense, its existence; but they must deny that it affords the slightest proof of an intention not to respect the boundaries between them and European nations, or of a desire to encroach upon the territories of Great Britain. Then when population reached , the territory applied for statehood. Louis, Missouri was the largest town on the frontier, the gateway for travel westward, and a principal trading center for Mississippi River traffic and inland commerce but remained under Spanish control until The Louisiana Purchase of [ edit ] Thomas Jefferson thought of himself as a man of the frontier and was keenly interested in expanding and exploring the West. Between and the s, the federal government purchased the actual land from the Indian tribes then in possession of it. Additional sums were paid to the Indians living east of the Mississippi for their lands, as well as payments to Indians living in parts of the west outside the Louisiana Purchase. He charged Lewis and Clark to "explore the Missouri River, and such principal stream of it, as, by its course and communication with the waters of the Pacific Ocean; whether the Columbia, Oregon, Colorado or any other river may offer the most direct and practicable communication across the continent for the purposes of commerce". By , Astor had taken over independent traders to create a profitable monopoly; he left the business as a multi-millionaire in

**Chapter 4 : Arctic UAVs game app - Frontier Scientists**

*The Frontier Thesis or Turner Thesis, is the argument advanced by historian Frederick Jackson Turner in that American democracy was formed by the American frontier. He stressed the process "the moving frontier line" and the impact it had on pioneers going through the process.*

Evolution[ edit ] Frederick Jackson Turner, c. They adapted to the new physical, economic and political environment in certain ways "the cumulative effect of these adaptations was Americanization. Successive generations moved further inland, shifting the lines of settlement and wilderness, but preserving the essential tension between the two. Every generation moved further west and became more American, more democratic, and more intolerant of hierarchy. They also became more violent, more individualistic, more distrustful of authority, less artistic, less scientific, and more dependent on ad-hoc organizations they formed themselves. In broad terms, the further west, the more American the community. Census of had officially stated that the American frontier had broken up. He sounded an alarming note, speculating as to what this meant for the continued dynamism of American society as the source of U. South Africa, Canada, Russia, Brazil, Argentina and Australia "and even ancient Rome "had long frontiers that were also settled by pioneers. The question is whether their frontiers were powerful enough to overcome conservative central forces based in the metropolis. In Australia, "mateship" and working together was valued more than individualism was in the United States. Roosevelt argued that the battles between the trans-Appalachian pioneers and the Indians in the "Winning of the West" had forged a new people, the American race. It explained why the American people and American government were so different from their European counterparts. It was popular among New Dealers "Franklin Roosevelt and his top aides [11] thought in terms of finding new frontiers. This is the great, the nation-wide frontier of insecurity, of human want and fear. This is the frontier "the America "we have set ourselves to reclaim. However, others viewed this interpretation as the impetus for a new wave in the history of United States imperialism. William Appleman Williams led the "Wisconsin School" of diplomatic historians by arguing that the frontier thesis encouraged American overseas expansion, especially in Asia, during the 20th century. Williams viewed the frontier concept as a tool to promote democracy through both world wars, to endorse spending on foreign aid, and motivate action against totalitarianism. Other historians, who wanted to focus scholarship on minorities, especially Native Americans and Hispanics, started in the s to criticize the frontier thesis because it did not attempt to explain the evolution of those groups. Mode in , argued that churches adapted to the characteristics of the frontier, creating new denominations such as the Mormons , the Church of Christ , the Disciples of Christ , and the Cumberland Presbyterians. The frontier, they argued, shaped uniquely American institutions such as revivals, camp meetings, and itinerant preaching. This view dominated religious historiography for decades. Micheaux promoted the West as a place where blacks could transcend race and earn economic success through hard work and perseverance. Historians have noted that John F. Kennedy in the early s explicitly called upon the ideas of the frontier. My call is to the young in heart, regardless of age "to the stout in spirit, regardless of party. Limerick points out that Kennedy assumed that "the campaigns of the Old Frontier had been successful, and morally justified. The frontier thesis is one of the most influential documents on the American west today. They argue that, "Frontier imagery motivates Fermilab physicists, and a rhetoric remarkably similar to that of Turner helped them secure support for their research. The bison herd still lives on the grounds of Fermilab. They emphasized the values of individualism, empiricism, simplicity, equality, courage, discovery, independence, and naturalism in the service of democratic access, human rights, ecological balance, and the resolution of social, economic, and political issues. If we can reach and cross this frontier, our generations will have furnished a significant milestone in human history.

*Frontier science matters Articles about frontier research, researchers and institutions Awardees Articles Recent publications by HFSP awardees Data Resources in the Life Sciences - Strasbourg International workshop held in Strasbourg, November*

An Explorer on the Frontier of Behavior By: In his Central King Building laboratory, with the assistance of undergraduate and graduate students, Fortune is challenging the unknowns of how the brain uses sensory information to control behavior. Fortune says that his research reflects a long-standing interest in the evolution of behavior. In college, as a biology major at the University of Chicago, I took a class in animal behavior and learned that the evolution of behavior is an especially complex and interesting phenomenon. This became my focus from then on. I learned that you can perform neuroscience experiments that provide insights about how the brain works which also address questions about the process of evolution. Attempting this commonplace behavior with my eyes closed or my feet anesthetized with lidocaine would make it a quite a dangerous adventure. Thus far, even the most sophisticated robots we are able to build cannot duplicate behavior that we take for granted every day. We have both multiple sensors and multiple compensatory systems. This is, in part, what makes it difficult to understand the neurophysiological mechanisms of behavior. Everything is connected, with many parts functioning in parallel. So if you alter or eliminate a part, the results often do not provide valid insights about the phenomena you want to study. This is why Fortune is working with weakly electric fish in the laboratory at NJIT and in the field in Ecuador, as well as with a species of wren native to the same South American country. Because this control does not involve the intervening and complicating mechanics of systems like muscles, the fish are an important ally in determining how neural codes are integrated in the brain to control behavior. These neural circuits allow various vertebrates and invertebrates to encode and comprehend motion in the surrounding world – very useful for activities such as finding a mate or prey, or to avoid being eaten. Although the researchers who first identified direction-selective neurons earned a Nobel Prize, how the related computations occur in the brain remained mysterious. In studying direction-selective neurons in electric fish, Fortune and his colleagues have described the computations in substantial detail. Tuneful Cooperation The plain-tailed wren is another animal that demonstrates a unique behavior that can help us understand how neural codes influence behavior, including how the brain enables complex cooperative activities. The behavior of special interest in this species of wren is the duet song that males and females produce so precisely and quickly that it can sound as if only one bird is singing. The great majority of birds do not duet in this manner. The wrens that Fortune is studying in Ecuador rely on sensory feedback to control their parts of the duet. Of course, some of us need more than a little practice. This is really a leading-edge of neuroscience.

**Chapter 6 : Why we need to stop talking about space as a frontier.**

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Even as Tumlinson claimed a radically different approach from the slow plodding of government-sponsored exploration, he relied on the same language and imagery of the frontier. The commercial space industry prides itself on newness and novelty, and yet the reliance on the same old metaphor both limits the imagination of humans in space and glosses over the social and historical problems of imagining a frontier that is empty and beckoning. The image of the tough, grizzly settler became associated with the frontier, but so too was the frontier a space to experiment with governance and freedoms. Get Future Tense in your inbox. Thus began a long tradition still being practiced of declaring new American frontiers. Science offers a largely unexplored hinterland for the pioneer. Of all these new frontiers, outer space was the most literal: Astronauts became the new cowboys, training for trips to the moon in the deserts of the American West. The frontier language challenged the government to make a sustained push toward settlement and exploration ever farther from Earth. But following the end of the Apollo program in , it became clear that the government was not going to fulfill the promise of the frontier metaphor. Eugene Shoemaker, who was involved in astronaut training, described in an oral history interview how he once tried to compare the American West with Apollo to encourage NASA not to retreat from the new frontier. The first book in which he outlined this vision was *The High Frontier* , published in . Today, Tumlinson continues to advocate for human space settlement and places himself in the company though not the net worth of Elon Musk, Jeff Bezos, and Richard Branson, who are all entrepreneurial pioneers of the space frontier. During his talk at Rice, Tumlinson explained his current initiative of asteroid mining. He framed it against a very specific lesson from the frontier: The asteroids will not be mined for precious minerals to return to Earth but rather for water to be used in space. If reading about mining asteroids makes you a bit nervous that human space settlement is bound to repeat environmental mistakes of the past, you are not alone. The frontier metaphor sets up outer space as a passive landscape with no purpose other than human sustenance. How we describe space can both expand and constrict our imagination. Advertisement I am not the first to point out the problems inherent in this metaphor, both in terms of its ideology of imperial expansion as well as its failure to account for the fact that Native Americans very much already occupied the frontier. In fact, even Tumlinson, who unabashedly uses this metaphor, is aware that it is imperfect. During his talk he took the time to address those who would urge him to find new language. Following slides showing images of exploring and settling the American West of Lewis and Clark, of settlers on horseback pulling covered wagons , Tumlinson assured his audience that in drawing on the frontier metaphor, he is not condoning the destruction of Native American communities or the spread of small pox. As if one can take the good parts of a metaphor, setting the unseemly ones aside. The Americanness of the frontier metaphor is also at odds with the need for international cooperation in the new era of space exploration. While the frontier might inspire Tumlinson and his fellow American baby boomers, does it have salience more broadly? One might be inclined to agree with Tumlinson that referencing the frontier is simply meant to garner interest and we should neither get hung up on its historical problems nor read too much into its Americanness: Just as the bad parts of the metaphor can be dismissed, non-Americans can find inspiration in the bigger vision that the frontier stands for. When we lean too hard on nationalistic language of the frontier and settlement, we imagine a far too narrow set of possibilities for being in space. In the early s, they offered a way of thinking about Earth humans included as an interdependent, self-correcting ecosystem. So can we apply that same thinking to the stuff beyond Earth? Instead of asteroids lying in wait as resources on the frontier, they can be imagined as part of a delicately balanced ecosystem. Or what if we undermined the very emptiness that the phrase outer space suggests by referring instead to the cosmos as outer place? Top Comment If someone challenged a writer for a satirical publication to write a piece lampooning ivory tower fixations on trivialities in the context of much more serious and exponentially larger issues, this would be a

fine effort. Join In Even as NewSpace declares its mission in service of all humanity, the insistence of understanding space as a frontier might not resonate with all of humanity. As NewSpace companies launch more rockets, raise more money, forge new partnerships, I hope they also start crafting new, varied language that will help us expand our thinking beyond the singular frontier to a plurality of extraterrestrial opportunity. This article is part of the new space race installment of Futurography , a series in which Future Tense introduces readers to the technologies that will define tomorrow. Lisa Messeri is an assistant professor of science, technology, and society at the University of Virginia. She is the author of Placing Outer Space. Follow her on Twitter.

**Chapter 7 : Revolution on the Tennessee Frontier | Department of History**

*The Frontier Conference is about the future of leaders of the industrial world, inviting the world's top innovators, thinkers, executives, visionaries, investors, and entrepreneurs to cross pollinate and re-think the future of each major industry.*

We live in an age of unparalleled technological and scientific progress, juxtaposed with a cascading series of poor social, health, and environmental choices that could bring our species to the brink of catastrophe. Within the past years alone, we have created significant advances in technologies to better control disease outbreaks, extend our lifespan, enhance global communication, increase our work productivity, and improve our overall quality of life. At the same time, we are facing major healthcare crises including diabetes, cardiovascular disease, cancer, and mental illness. Despite our best efforts and technological advances, we have not yet conquered these and other life- and health-interfering disorders. In addition, health disparities are increasing and the year rise in life expectancy is flattening. Examples from clinical and research areas such as mind-body medicine, placebo, psychoneuroimmunology, and neuroscience, remind us that our capacity to activate our own internal healing response is within our human capabilities. Just a few decades ago, the theory that the nervous system was directly connected to the immune system was highly controversial; today, it is mainstream science— with recent scientific studies uncovering deeper discoveries of vagal-immune and vagal-microbiome communications, 2, 3 and a most recent scientific report suggesting functional lymphatic vessels may reside within the brain. Despite these groundbreaking scientific discoveries, translation of these data into interventions for patients to facilitate their own health and healing remain limited. To empower healthcare providers, their patients, and the general public to facilitate their own healing requires an advancement in knowledge and practice that can only occur through the multidisciplinary integration of perspectives on mechanisms of healing and health maintenance. Such an integration is rather daunting to embark upon, given the current culture of academic and clinical specialization, as we are taught to specialize early in our careers as academics and clinicians, and rarely have the opportunity for cross-disciplinary dialogue. While specialization is intended to lead to discoveries through complete focus and immersion in a single area, the emergence of significant breakthroughs in science and medicine has often occurred as a result of interdisciplinary communication and collaboration. Indeed, Dr Robert Ader, cofounder of PNI, understood that the advances in his field would begin with interdisciplinary inquiry and later lead to a dissolution of arbitrary borders between disciplines, leading to a more global, networked understanding of health: Disciplinary boundaries and the bureaucracies they spawned are biological fictions that can restrict imagination and the transfer and application of technologies. The signal molecules of the nervous and immune systems are expressed and perceived by both systems. We propose that such a network may be found in what is currently being termed the biofield, a field of energy and information that reflects and guides the homeodynamic regulation of a living system, and as such influences and is influenced by consciousness. While the term biofield itself is fairly new coined in at a National Institutes of Health meeting; see Rubik et al, this issue, discussion on the importance and role of consciousness, energy, and information to create and guide emotional, mental, and physical functioning has been described by numerous diverse cultures and used in medical systems for thousands of years Jain et al, this issue. Despite the careful definition and description of biofield-related concepts in these cultures, our modern descriptions and understandings of such concepts and how they may relate to healing processes are still in their nascent stages. As is evident in this Special Issue, even among biofield science researchers, there is disagreement about whether vitalistic concepts such as chi and prana are essential for describing the biofield, whether the biofield can be reduced to bioelectromagnetic emanations on different levels of scale, or whether the understanding of the biofield at its core demands a new understanding of physics and biology that incorporate models of consciousness eg, see papers by Jain et al, Rubik et al, Kafatos et al in this issue. Further, it is not well understood whether mechanisms underlying results from proximally practiced biofield therapies in pre-clinical and clinical studies see Gronowicz, Bengston, and Yount and Jain et al, in this issue are at all related to laboratory studies examining the effects of distant healing intention see Radin, Schlitz, and Baur, this issue. The questions of how to best integrate

biofield practitioners into healthcare systems are crucial to address see Guarneri and King, this issue. In addition, the increasing use of devices that are used to influence aspects of the biofield to enhance a healing response see Muehsam et al, this issue , represents yet another frontier with respect to research and clinical application. Biofield science, then, currently finds itself in a highly controversial, not-yet-well-understood, and sometimes academically contentious environment. Current funding for the field of biofield science is more strongly directed toward industry applications and less toward basic science and clinical application. Given the current controversies, challenges to conceptualization and measurement, and general lack of funding, why should we consider advancing the field of biofield science? First, the roots of biofield concepts and practice have persisted for thousands of years and remain the basis for many medical interventions and self-healing practices across the globe. The ongoing use of biofield-based healing practices, in terms of both self-practice and practitioner-assisted modalities, has continued to flourish over time, with increasing evidence to support their use in certain difficult-to-treat clinical populations, with no known adverse effects see Jain et al, this issue. Arguably, the use of biofield systems and therapies over millennia, while provocative, may not in and of itself warrant scientific investigation. However, in addition to this preponderance and longevity in clinical application based on concepts akin to biofield, recent empirical advances in bioelectromagnetics suggest that perturbation of electromagnetic aspects of the biofield involving very weak physical energies can substantially impact health processes see Muehsam et al, this issue. These findings are driving industry innovation. The application of bioelectromagnetics in psychiatric and neurodegenerative disorders is growing rapidly. As respected leaders who have been forwarding the science and practice of biofield-related areas for decades, each of these organizations saw the value in a collaborative acceleration of biofield science and practice. Invited researchers and scholars represented a wide range of scientific disciplines, including biophysics, physics, biology, clinical psychology, psychoneuroimmunology, psychoneuroendocrinology, neurosciences, engineering, and medicine. They were joined by leading biofield practitioners who were specifically selected for having been involved in scientific studies of biofield therapies. This special issue on Biofield Science and Healing reflects the rich, ongoing exchanges within this interdisciplinary group. It is hoped that this issue will catalyze discussion and advance multidisciplinary inquiry into biofield science. This multidisciplinary effort will be supported through the emergent collaborative backbone organization, 12 the Consciousness and Healing Initiative CHI , which fosters interdisciplinary science and provides scientifically-based educational resources in consciousness and healing across institutions and disciplines. However, its potential payoff in terms of service to society could be transformative. This special issue on Biofield Science and Healing is the reflection of a growing interdisciplinary, collaborative effort to advance this rapidly evolving science and discipline. We look forward to collectively supporting these efforts and facilitating the individual and societal health empowerment that may emerge with a clearer understanding of the biofield. Dr Muehsam disclosed that he is a consultant for Rio Grande Neurosciences. Dr Chopra disclosed that he is co-owner of the Chopra Center for Wellbeing as well as payments and royalties for activities outside the submitted work. Dr Guarneri disclosed that she is a consultant for Atlantic Health Systems outside the s ubmitted work. The other authors had no conflicts to disclose. National Center for Biotechnology Information. US health in international perspective: Accessed September 25, Sundman E, Olofsson PS. Neural control of the immune system. Nervous and immune system interactions. Structural and functional features of central nervous system lymphatic vessels. The emerging field of human social genomics. Accessed October 6, Top-down and bottom-up mechanisms in mind-body medicine: Historical perspectives on psychoneuroimmunology. Psychoneuroimmunology, Stress, and Infection. Ethics of the electrified mind: Understanding the value of backbone organizations in collective impact: Stanford Soc Innov Rev.

**Chapter 8 : IAS Conference Review - Frontier Science**

*Beverly Rubik earned her Ph.D. in biophysics at University of California at Berkeley. She is internationally renowned for her research on the biofield and subtle energies and is president & founder of the Institute for Frontier Science, a nonprofit laboratory in the San Francisco Bay Area.*

Here, he elaborates on cutting-edge research into the ways everyday forms of touch can bring us emotional balance and better health. A pat on the back, a caress of the arm—these are everyday, incidental gestures that we usually take for granted, thanks to our amazingly dexterous hands. They are our primary language of compassion, and a primary means for spreading compassion. Advertisement X A three-course professional certificate series that teaches you the what, why, and how of increasing happiness at work. This research is suggesting that touch is truly fundamental to human communication, bonding, and health. In my own lab, in a study led by my former student Matt Hertenstein now a professor at DePauw University, we asked whether humans can clearly communicate compassion through touch. We built a barrier in our lab that separated two strangers from each other. One person stuck his or her arm through the barrier and waited. The person whose arm was being touched had to guess the emotion. Given the number of emotions being considered, the odds of guessing the right emotion by chance were about eight percent. But remarkably, participants guessed compassion correctly nearly 60 percent of the time. Gratitude, anger, love, fear—they got those right more than 50 percent of the time as well. We had various gender combinations in the study, and I feel obligated to disclose two gender differences we found: When a woman tried to communicate anger to a man, he got zero right—he had no idea what she was doing. Ethologists who live in different parts world quickly recognize this. Nonhuman primates spend about 10 to 20 percent of their waking day grooming each other. If you go to various other countries, people spend a lot of time in direct physical contact with one another—much more than we do. This has been well-documented. He observed these conversations for the same amount of time in each of the different countries. What did he find? In England, the two friends touched each other zero times. In the United States, in bursts of enthusiasm, we touched each other twice. More on Touch Check out this research on the positive effect of touch in schools, and learn how important touch is in communicating positive emotions. But in France, the number shot up to times per hour. And in Puerto Rico, those friends touched each other times! Of course, there are plenty of good reasons why people are inclined to keep their hands to themselves, especially in a society as litigious as ours. But other research has revealed what we lose when we hold back too much. Similarly, research by Darlene Francis and Michael Meaney has found that rats whose mothers licked and groomed them a lot when they were infants grow up to be calmer and more resilient to stress, with a stronger immune system. This research sheds light on why, historically, an overwhelming percentage of humans babies in orphanages where caretakers starved them of touch have failed to grow to their expected height or weight, and have shown behavioral problems. We also know that touch builds up cooperative relationships—it reinforces reciprocity between our primate relatives, who use grooming to build up cooperative alliances. There are studies showing that touch signals safety and trust, it soothes. Basic warm touch calms cardiovascular stress. Touch had turned off the threat switch. Touch can even have economic effects, promoting trust and generosity. But it made a big difference: Those who were touched were much more likely to cooperate and share with their partner. These kinds of benefits can pop up in unexpected places: In a recent study out of my lab, published in the journal *Emotion* we found that, in general, NBA basketball teams whose players touch each other more win more games. Touch therapies Given all these findings, it only makes sense to think up ways to incorporate touch into different form of therapy. Tiffany Field has found that massage therapy reduces pain in pregnant women and alleviates prenatal depression—in the women and their spouses alike. And educators, take note: A study by French psychologist Nicolas Gueguen has found that when teachers pat students in a friendly way, those students are three times as likely to speak up in class. Another recent study has found that when librarians pat the hand of a student checking out a book, that student says he or she likes the library more—and is more likely to come back. Touch can even be a therapeutic way to reach some of the most challenging children: Some research by Tiffany Field suggests that children with

autism, widely believed to hate being touched, actually love being massaged by a parent or therapist. Greater Good wants to know: Do you think this article will influence your opinions or behavior?

Chapter 9 : Biofield Science and Healing: An Emerging Frontier in Medicine

*The American frontier comprises the geography, history, folklore, and cultural expression of life in the forward wave of American expansion that began with English colonial settlements in the early 17th century and ended with the admission of the last mainland territories as states in*

His one year, , at the Johns Hopkins University, which awarded him a doctorate in , was less fruitful, although his interest in economic history was quickened by Richard T. Ely and in nationalism by Woodrow Wilson. Huntington Library, Tu Box Many of the distinctive features noticeable in American traits and institutions, he believed, stemmed from a unique environment and particularly from the presence of a receding frontier. The repeated rebirth of civilization among pioneers whose cultural patterns were disrupted by contact with raw nature and by mingling with other settlers from different backgrounds helped endow the American people with characteristics and values different from those of their European ancestors. Among these Turner listed coarseness and strength, an inventive turn of mind, physical and social mobility, a restless energy, a strong spirit of self-reliance, dominant individualism, an emphasis on materialism, and, especially, a quickened faith in democracy and the national destiny. From the turn of the century to the s the frontier interpretation dominated historical thought. When he finally left Wisconsin for Harvard University that year, he did so only as a protest against the anti-intellectual tendencies of some of the Wisconsin regents who seemed to be threatening scholarship in its pure forms. In the meantime his own interests had turned to a second explanation of the uniqueness of the American past: As population moved westward, he reasoned, successive geographic regions were occupied, each differing from the others in climate, soil, topography, and other natural conditions. Turner believed that the political history of the United States could be understood only as a series of adjustments and compromises between sectional interests. This was the view he stressed in the one book he completed during his lifetime, *Rise of the New West: The Nation and Its Sections* Turner retired from Harvard University in to dedicate full time to this study, living first in Madison, then in moving to a post as senior research associate at the Henry E. His death in spared him knowledge of the assault on his theories that gained momentum during the s and continued for two decades. This wave of anti-Turnerism ran its course by the s. It has been followed by a new period in which scholars in several disciplines have begun testing aspects of his frontier hypothesis, a process seemingly destined to continue for many years before the exact effect of the pioneering experience can be appraised. *A Study of the Trading Post as an Institution. Guide to the Study and Reading of American History. With an introduction by Avery Craven. Unpublished Writings in American History. Edited by Wilbur R. With an introduction by Ray Allen Billington. Becker, Carl Frederick Jackson Turner. Pages in Howard W. Odum editor , American Masters of Social Science: Benson, Lee Turner and Beard: American Historical Writing Reconsidered. Wisconsin Magazine of History Massachusetts Historical Society, Proceedings Craven, Avery Frederick Jackson Turner. Pages in The Marcus W. Jernegan Essays in American Historiography. Edited by William T. Curti, Merle Frederick Jackson Turner. A Collection of Essays on the Historian and the Thesis. University of Kansas City Review Pacific Historical Review Colonial Society of Massachusetts, Transactions Pages in Merrill Jensen editor , Regionalism in America. Cite this article Pick a style below, and copy the text for your bibliography.*