Science in science fictions: putting H.G. Wells' The Time Machine in the spectrometer.

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Abstract: In this paper, I look into the aspect of the scientific correctness and way a science fiction may predict futuristic effects on our society as well as affect man's vision in both academically as well as in popular culture. For this purpose, I take H.G. Wells's 'The Time Machine' as a specimen on a petri dish. I look into the concept of evolution presented in The Time Machine. I also investigate how the ideas presented by Wells in The Time Machine about time travel fare with the science of thde last century.

Introduction

The advent of science fiction can be traced back to The Blazing World by Margret Cavendish in mid 1600s. However, Margret Cavendish's work was more of a fantasy work. Modern science fiction as a genre can be thought as born with the publication Frankenstein by Mary Shelley in 1818. H.G. Wells's 'The Time Machine' was published in the year 1895, ten years prior to the publications of the famous work on Special Theory of Relativity(STR) by Einstein in 1905 [1]. H.G. Wells himself and many other deem The Time Machine and few of his works as 'scientific romances' [2]. Many scholars don't see science fiction as prophecy, though the writers often boast its success as prophecy [3]. However, we see a number of

science fiction descriptions coming into life in real world decades or centuries later. For instance, the story of a large cannon leaving for the moon was penned down as a fiction by Jules Verne in 1865, entitled 'De la Terre à la Lune' in French. It was translated to English in 1876 [4]. Humans then set foot on the moon on 20 July 1969, hundred and four years later [5], making the fiction becoming akin to prophetic.

The Time Machine forays into a future of society of what has become of humans with a machine which can take a person to the future and back to present. The author calls it a 'Time Machine'. The unnamed person who narrates the journey to future in The Time Machine is referred to simply as the Time Traveller. The Time Traveller travels to 802701 AD in his first of the two journeys to alternative time from the present. As he comes back to the present, he describes what he saw in the journey through time and the society in the year 802,701 A.D. There he encounters the childlike humanoids, the Eloi who lived on fruit based diets and lived in the futuristic yet deteriorating buildings. They spoke a language incomprehensible to the Time Traveller and it was difficult for him to communicate with the Elois due to their small attention span, indiscipline and lack of interest to learn probe for new learning. They appeared to be happy and jolly in the day time but feared the dark. He then encounters another species of humanlike structure, the Morlocks. Contrary to the Eloi, the Morlocks lived in the underground, cannot bear the sunlight, and apparently took care of the industrial works. The Eloi was supposedly the aristocrats of the society kept on adapting to the changing time and similarly, the Morlocks were the resultants of the adaptations of the industrial workers to their living conditions who lived dingy and poor hygiene areas of the industrial areas.

Scientific Evidence of plausibility The Time Machine's depiction of evolution of humans

The Morlock and Eloi as races evolved to adapt with their environment, as explanations given by the Time Traveller as [6] –

> "At first, proceeding from the problems of our own age, it same clear as a daylight to me that gradual widening of present merely temporary and social difference between Capitalist and the Labour was the key to the whole position. No doubt it will seem grotesque enough to you – and wildly incredible! – and yet even now there existing circumstances to point that way. There is the tendency to utilize underground space for less ornamental purposes of Civilization; there is the Metropolitan Railway in London, for instance, there are new electric railways, there are subways, there are underground workrooms and restaurants, and they increase and multiply. Evidently, I thought this tendency had increased till Industry had gradually lost its birthright in the sky. I mean that it had gone deeper and deeper into larger underground factories, spending a still-increasing amount of its time therein, till, in the end –! Even now, does not an Easy-end worker live in such artificial condition as practical to be cut off from the natural surface of the earth? .....
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> .....The too-perfect security of the Upper-worlders had let them to a slow movement of degeneration, to a general dwindling in size, strength, and intelligence. That I could see clearly already. What had happened to the Upper-grounders I did not yet suspect; but from what I had seen of the Morlocks – that, by the by, was the name by which this creatures were called – I could imagine that the modification of human type was even far more profound than among the "Eloi," the beautiful race that I already knew."

Without delving into the socio-cultural aspects of human evolution and putting forth any arguments and discussions about the class differences of Haves and Have-nots, I will concentrate on the physiological evolution of the human race as depicted in The Time Machine. 802,701 AD is long way to go for humans to evolve to two different races like Eloi and Morlocks where languages too changed to an altogether different form. The Homo sapiens or us were evolved about 300,000 years

back in Africa. It took 230,000 years to make us cognitively able to communicate stories and spread out of Africa, and about 12,000 years from now, we started doing agriculture. Then we could come to the civilizations, kingdoms, Christianity and so on [7]. The way Homo sapiens have evolved from 300,000 years back to today's tech savvy beings, many of us with prosthetic body parts – including dental fill-ups and implants. It doesn't point to any reason why the 1885's human race cannot evolve to Eloi and Morlocks.

A recent study on the high altitude Tibetan women by a group lead by Cynthia Beall of Case Western Reserve University has found observations supporting evolution and natural selection due to the environmental and sociocultural factors [8]. They studied the lifetime reproductive success of the low oxygen highlands of Nepal by enrolling population of 39 year and older married or pregnant ethnic Tibetan women who were lifelong natives of Upper Mustang. The found that –

> "Populations with a long history of exposure to severe stress and the opportunity for natural selection provide an ideal context to address these challenges. A few populations have thrived for thousands of years under high-altitude hypoxia and exhibit distinctive traits consistent with positive natural selection. Today's ethnic Tibetan population descends from ancestors with roughly 10,000 y of year-round high-altitude residence. Ethnic Tibetans have distinctive biology thought to reflect adaptations in the oxygen delivery system that counter environmental hypoxia."

In 10,000 years, the Tibetan population has evolved to cope with the environmental hypoxia of the high altitudes of the Tibetan region. Their distinctive sociocultural practices, which have been an integral part of the community, and their ways to live to adapt to the low air density of the Himalayan heights induced changes in the way oxygen is supplied to the body. Though the two species that becomes the remnant of human race in the The Time Machine, specially the Morlocks,

appear too strange to easily fit in to one's futuristic imagination, the work by Beall et. al. is evidential to project to the plausibility of the possible state of evolution as indicated in The Time Machine.

The Time Machine as a source for popular culture

The concept of time travel as presented in The Time Machine has intrigued science enthusiasts, storytellers, moviemakers, moviegoers and the layman to do their bits about time travel. For instance, The Time Machine was adopted to make sci-fi film, with the same title as the book, in 1960. It was remade in 2002. The action packed series of movies which started with The Terminator in 1984 garnered great interest amongst moviegoers for generations. The Terminator derived two major components of its storyline from The Time Machine – time travel and an apocalyptic future, albeit cyborg based. The franchise made six movies based on the storyline, the latest being released in 2019.

Another film which was based on the concept of time travel that is worth mentioning is Back to the Future. It was the highest grossing movie of the year 1985. The movie was based on the idea that a time machine would activated on of travelling at velocity of 142kmph. Fate ensues that it takes Marty, the protagonist, back to 1955 so that he could alter the past to make the lives of his family and Doc, the inventor of the time machine, better.

On the front of popular science writings, The Time Machine has inspired scholars to work the idea who explored the possibility of making a time machine. In How to Build a Time Machine, Paul Davies explores if the theories in physics allows time travel [8]. Paul Davies exclaims –

> "If you could magically squash the earth to half its diameter (retaining all its mass) it's surface gravity would be twice as big, and so would be the timewarp. Go on compressing, and

effect rises. When the radius reaches the critical value of 0.9cm, time stands still. Nothing can escape!"

There are other popular science writings which delve into the matter of time travel with supporting scientific foundations and yet easy to understand by a person with no science backgrounds. One such book is Time Travel in Einstein's Universe by J. Richard Gott III. Gott quotes extensively from The Time Machine to introduce, rather reintroduce, the readers to the popular imagination of time travel! The list is non exhaustive.

Time Travel in Science and how it compares with the Time Travel of The Time Machine

"Any real body must have extension in four directions: it must have Length, Breadth, Thickness, and – duration..... There are really four dimensions, three which we call the three planes of Space, and a fourth, Time. There is, however, a tendency to draw an unreal distinction between the former three dimensions and the latter, because it happens that our consciousness moves intermittently in one direction along the latter from the beginning to the end of our lives." – Time Traveller in The Time Machine [6]

Probably the first person to call time as the fourth dimension to describe the mechanics of objects was Joseph-Louis Lagrange. H.G. Wells built on the idea of time as fourth dimension just like the three spatial dimensions of Euclidean geometry where one can travel through the fourth dimension – time, for that matter there is nothing wrong in calling it the first dimension! He draws comparisons between moving along the spatial directions like left-to-right, backward-forward and up-down with travelling along time to past or futures. He draws parallel between moving upwards and moving along time to past or future in the sense that

due to gravity it is difficult to move upwards and one needed ways to have upward motion. Hot air balloons could take one up to certain heights of sky in way back 1783. Now one can overcome the gravity of Earth to go to the outer space. Similarly, argues the Time Traveller, if one can design something to overcome the hidden hindrances against time travel, one can easily go about to different times and he states that he is working on the same. Ironically, gravity was the pulling back string to restrict upward motion in H.G. Wells' parallel-drawing exercise between space and time as dimensions, now scientists are looking into the science version of time travel in the context of space-time curvature due to gravity! This understanding of time as the fourth dimension just like the spatial ones where one can travel this side to that side has led many haywire and to areas as grey as pseudoscience.

It was after the Einstein's publication of STR [2], the idea of time as the fourth dimension became a part of equations of mechanics. The Lorentz transformations of space-time took time as the fourth dimension, albeit as with the 'iota'. It was a result of the STR and the Lorentz transformation that the world came to know about time dilation where time slows down in a moving frame of reference as compared to a frame at rest. That is if a rocket is fired and it is let to rotate around the world a few times, a clock kept in the rocket will be slower than an identical clock on earth. Now, how slow will it run? The clock on the moving rocket will be slower by a factor of square root of one minus square of the ratio of the velocity of the rocket to velocity of light. If the velocity of the rocket gets to the velocity of light in vacuum, then time slows down enough to stand still! If the velocity of the rocket gets past the velocity of light in vacuum, time becomes strange and one may move of strange new universe! However, there are two problems with such time travels. First – the violation of causality, it is well accepted that the cause of

anything has to come before its effect. If time travel to past can happen, the effect can precede the cause. It very lucidly elucidated by the 'grandfather paradox'. In my version of grandfather paradox, I go back in time and take my grandfather on a bike ride, even before my father was born. In an unfortunate turn of events, my grandfather dies due to skidding of my bike on the treacherous icy mountain road of Rohtang Pass. How can I come to existence if my father was not born at all? Second, nothing with mass can travel faster than light as per the STR. If anything travels at velocity of light in vacuum, its mass becomes infinite and it becomes imaginary if it breaks the barrier of velocity of light. It is not to say with finality that nothing can move faster than the velocity of light, but if that happens then the STR has to modified, if not discarded. As the STR will not be in its original shape, the proposition of something moving faster than light will lead to time travel too will be displaced!

In 1908, Hermann Minkowski formulated the four dimensional Minkowski space-time8. However, in Minkowski's space-time, one cannot travel forward or backward in time to future or past as envisaged by Wells in the The Time Machine. An event or a person just exists at a point in the space time, it doesn't move anywhere. The world-line in the Minkowski space-time represents the whole history, the whole life of the object. Now, how can time travel be possible in Minkowski space-time? As seen by an external observer at rest, the space-time curves under the influence of gravity along the geodesics (shortest path in simplest words) though for the object/person, its world-line is a free fall. If closed time-like lines (CTL) in Minkowski space are obtained in then one can go back to its starting point. In other words, one can time travel backwards. In 1949, Godel constructed what is now known as Godel metrics in which he found that the framework of Einstein's General Theory of Relativity(GTR) allows Closed Time-like

Curves(CTC) which allows one to travel back to the past [10]. Frank Tipler found that if one can construct a sufficient large rotating cylinder, CTLs can be obtained as a solution of the general relativity equations. And a time machine can be made [11]. The catch is that infinitely long cylinder needs to be of mass of at least ten times the mass of sun and it must be rotating a speed of a few billion rotations a second. As easy as it gets!

To Continue

Though theoretically there are solutions to the complex equations of GTR which allows CTCs i.e. a kind of time travel, a time machine is still a play thing of fantasy and science fiction dreamers. Even after 130 years of The Time Machine's first publication, we still all read and fantasize about a time machine and what we would do if we have one!

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