Chapter III

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Human Beings and Technology: A Growing Hybridization

Technology has become a central part in the life of human beings. Its necessity in every aspect of life results in bringing up new inventions to the world. Human beings and technology are blended together and it looks impossible to remove technology from the life of human beings. Technological development and human beings grow hand in hand together. The development of technology has its impact on human beings. The bond between human beings and technology is irreplaceable in the current scenario. Technology is utilized to do things easier by reducing time and space.

This chapter explores and analyses the role of cyborgs in the technological society in Neal Stephenson's select novels *Zodiac*, *Snow Crash*, *The Diamond Age*, *Cryptonomicon* and *Seveneves*. This chapter traces the development of technology like industrialization; digitalized communication; hacking; virtual reality; digitalized education, advancements in nanotechnology; information security; and parthenogenesis.

Human beings are the subject and object of anthropology. They are machine producers and operators. Human-centered activities are questioned due to the consequences faced by society. Fashioning of selves is done through technology in the technologically advanced society. Each technological invention like typewriter, pen, train, boat, plane, cell phone, laptop and so on are also considered to be anthropological subjects. The enhancement in technology and its interaction in the life of human beings lead to self-transformation, which occurs when the mental activities are tailored with the physical changes due to the interaction of technology. This alters human nature by

making the human beings to live as human cyborgs in the society. When human beings utilize a machine or an instrument or a medium to ease their life, they use technology. When they become too engrossed into technology they are considered to be cyborgs. Since they are integrated with technology, they become inseparable from it. The role of cyborgs in the technological society is analysed in the select novels of Neal Stephenson.

According to Andy Clark, Cyborgs are "Human-technology symbionts" and they are the mixture of culture, biology and technology (Clark 3). He further explains cyborg is a "potent cultural icon of the late twentieth century. It conjures the images of human-machine hybrids and physical merging of flesh and electronic circuitry" (Clark 4). Human beings are considered to be cyborgs as they are using technology as their physical and mental extension. In Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence, the author says:

> My body is an electronic virgin. I incorporate no silicon chips, no retinal or cochlear implants, no pacemaker. I don't even wear glasses (though I do wear clothes), but I am slowly becoming more and more a cyborg. So are you. Pretty soon and still without the need for wires, surgery, or bodily alterations, we shall all be kin to the Terminator, to Eve 8, to Cable … just fill in your favorite fictional cyborg. Perhaphs we already are. For we shall be cyborgs not in the merely superficial sense of combining flesh and wires but in the more profound sense of being human-technology symbionts: thinking and reasoning systems whose minds and selves are spread across biological brain and nonbiological circuitry. (Clark 3)

The technological enhancement and its implementation in human life are discussed in this chapter.

The first novel *Zodiac* explores technological development in the industrial sector. The technological enhancements result in replacing the old transformers with the new ones, manufacturing artificial pesticide Agent Orange and invention of new microbes to clean the Boston harbor water instantly.

The Boston harbor has been polluted since the late 1800s. The living organisms in the harbour get much affected due to contamination of water. Herbicides, heavy metals and PCBs are responsible for the heavy water pollution. The wastages and heavy metals found in Agent Orange, a major herbicide manufactured in Boston, sags the purity of water down. Polychlorinated biphenyls (PCBs), an organic chlorine compound, used as a coolant in electrical apparatus like transformers, are the toxic substances. When these substances come in contact with human beings and other living organisms it results in serious health issues.

GEE, an environmental activism group, is very much concerned about environmental pollution. When Taylor enters the office initially, he notices many catchy phrases inside the building. A sticker is pasted in front of his eyes that "SAVE THE WHALES and something about the BABY SEALS" (Stephenson, *Zodiac* 7).The illegal dumping of toxic wastes from the industries affect the aquatic organisms highly. Taylor says that "PCBs in their environment will show up as a much higher concentration in their livers" (Stephenson, *Zodiac* 34). The presence of chemicals and toxins in aquatic organisms depend upon the concentration of toxins in their environment. Higher the concentration of chemicals and toxins higher is the health issues of aquatic organisms. This novel depicts the toxicity of Polychlorinated Biphenyls (PCBs) in aquatic organisms and human beings who consume it.

During Taylor's project, he has collected the samples of lobsters and fish. He found out the concentration of polychlorinated biphenyls (PCBs) in the harbor water with the help of a fisherman's family. Initially he has identified the presence of PCB in the harbour later he has noticed a sudden disappearance of PCBs. The production of PCBs has been banned by United States federal law in 1978 due to its pollution.

The PCBs are used as a cooling agent in some technological inventions. At the same time it will be a dangerous thing when they get leaked out. Though the chemists and the technicians of Basco industries know everything about the environmental degradation, they did not give way to take steps against the illegal activity. Neal Stephenson explains this as "Most of these blunders involve toxic chemicals that any competent chemist should know to be dangerous. They pump these things into the environment and don't even try to protect themselves" (Stephenson, *Zodiac* 58).

Michael Moore explains in his article that flounder fish is seriously affected by liver tumors due to water pollution. The tumors have been reduced after the cleaning process started in the harbor. This article further explains that:

However, environmental conversation is never finished. New water quality challenges are emerging – notably, microplastics, and pharmaceuticals in wastewater, which are not currently regulated. As the Trump administration pushes to reduce environmental regulation, it bears emphasizing that without federal legislation and legal action, Bostan might still have the nation's dirtiest harbor today. (Moore 1)

The quality of water gets changed due to the addition of toxic wastes like micro and Nano plastics and wastages of pharmaceuticals into the water bodies. These wastages have the capacity to change the nature of the natural environment due to its highest

contamination. Honorable President Trump's administration in America has taken steps to prevent water pollution. Human beings should have a certain concern for saving nature and restoring its purity. The Clean Water Act was passed in 1972 in order to save nature. Though many laws have been enacted by the government, it is people's responsibility to protect nature. Technology is advanced but technological wastages like micro and Nano plastics and pharmaceutical wastes are not properly disposed by human beings. Man utilizes technology to its core but fails to save himself and the environment from its negative consequences. Technology can be used in the same way to dispose the technological wastes without harming the environment.

Basco industries have dumped all the wastes directly into the harbor. The pH level of the wastages is 13 while the actual permitted level of pH in their wastages should be 8. pH stands for potential of hydrogen, whereas H is the chemical symbol for hydrogen. pH is a scale used to measure the value of water. The pH level of pure water is 7 and it is said to be neutral. If the pH level is high then it is base and the lower level of pH is said to be acidic.

The result of the pollution is worse than the result of bombs and guns in war. This environmental abuse due to the technological upgradation results in certain consequences like the old men with tumors and the affected mothers of the children. These are the evidences of the Boston harbour water pollution. The companies did not even accept that the chlordane is hazardous. Chlordane, a chemical compound, is a white solid used as a pesticide. It takes many years to degrade and to enter the ground water gradually. Exposure to this pesticide results in serious health issues like diabetes, obesity, and cancer. This has been banned since 1988 in America. The natural pesticides are

replaced by the artificial pesticides due to technological development. The artificial pesticides and the presence of chemicals in it, pollutes the natural environment and human health.

Every chemical reaction has some input and output. The output of the chemical reaction does not disappear but it can be changed with the other chemical reaction which also has certain output. Taylor, while taking samples of lobster from the north of Spectacle Island, identifies that he "couldn't get any PCB readings at all" (Stephenson, *Zodiac* 136). Meanwhile Taylor came to know that the Basco industry had brought a bunch of transformers in 1956. In order to make space for new transformers, they have to clear all those old ones, which are full of PCBs. Taylor explains that "lake full of toxic waste somewhere … and just dumped them on the floor of the Harbour somewhere" (Stephenson, *Zodiac* 165). The old transformers are leaking PCBs under the water.

Taylor comes to know that Basco industry has acquired a bio engineering company, which produces toxic eating bugs to clean the water of harbor instantly. These microbes can eat the toxins from the water and in return it can also produce toxins. To get rid of those PCBs in harbor, Basco has used new bugs that can eat covalent chlorine atoms from the water so that the water will become toxic free. These bugs die after eating those toxins. Hence the water can become toxic again. The company releases the bug into the harbour water without completing the full research. This paves way for toxins to grow further. They have not got permission from the Environmental Protection Agency (EPA) for releasing the new bug in the harbour water. Neal Stephenson brings out the rapid technological growth like inventing new bugs with covalent chlorine atoms. The lack of concern for nature and lethargic way of handling technology opened the door for pollution.

Taylor and his team work hard to stop the companies from dumping the toxic wastes into water. Neal Stephenson explains the team work of GEE regarding pollution and danger of toxic waste as:

> We've discovered a big pipe sticking out into the ocean that's putting very large amounts of hazardous wastes right into the water. In fact, of the six pollutants that had EPA has licensed you to discharge into water at this point, you're exceeding the legal limit on all six. And since they're very dangerous substances, what you're doing is illegally endangering the health and welfare of everyone who lives in this region, which is a lot of people. (Stephenson, *Zodiac* 80)

GEE takes the responsibility to stop all those devastation due to the illegal disposing of chemicals in the harbor. This is because of the lack of technological and ecological awareness among human beings. Taylor and his friends catch lobsters from the harbor water in order to find the chemicals deposited inside their body. Taylor uses Boston University lab for doing the research. He finds that the liver of the lobsters are very much affected by tumors and necrosis. Tumors are the abnormal growth of a tissue without control. Necrosis, a kind of cell injury, results in premature death of cells in living tissue. In human beings or other organisms, the waste substances in the body are filtered by the liver. Too much of chemical substances inside the body affect the liver highly. Taylor expresses that "We checked them for obvious signs, like tumors or necrosis" (Stephenson, *Zodiac* 110). During the lab research, they have identified organic metals and organic bad things and they have put those details in their database. They found a greasy substance inside the lobster's liver and soon they identified it as PCBs. This is explained as:

Rotted away, inside the body, leaving just a puddle of black stuff. Surrounded by

blobs of yellowy material, vesicles or sacs of something that I'd never seen inside

a lobster before. Some kind of toxin that the liver had desperately tried to remove

from the lobster's system, killing itself in the process. (Stephenson, *Zodiac* 113)

The liver of the lobster looks black surrounded by yellow material. The liver is

trying to pull out all those chemical toxins from the body but it fails in the process.

The liver lost its nature of purifying the toxins due to heavy contamination. An article in

the journal named *Environmental Research* explains the effects of eating contaminated

fish. It states that "Intellectual impairment was also observed in children born to women

who had eaten fish contaminated with PCBs in the United States" (2-11). The illegal

activities are hidden under the screen of technology. They ruin the life of living organisms.

The aquatic lives are on their deathbed due to higher concentrations of PCBs in the

harbor. Human beings who consume the affected aquatic organisms are also affected by

various health defects. These consequences of water pollution due to abusive technological

enhancement can be reduced only through the proper way of disposing it.

Taylor has explained a drastic incident that happened at a rice bran oil company in

Japan. In 1968, rice bran oil, produced by a private sector in Japan, was contaminated

with PCBs and PCDFs while manufacturing. People and poultry are affected with serious

health issues like difficulty in breathing, eye problem, irregular menstruation and lower

immune response after consuming the rice bran oil. Technological implementation in all

the fields makes the work easier but the improper maintenance of the technological tools

results in adverse consequences. Due to the leakage of PCBs, people of Japan are affected

by chloracene, a skin disease caused by toxic chemical compounds. Taylor says that the

plague has reached America due to water pollution. Taylor also explains that PCBs

"dissolve themselves in human fat cells and they never leave" (Stephenson, *Zodiac* 114).

Once the bad consequence of a technological invention or a technological tool is

identified, it should not be used further.

Neal Stephenson has explained the technological crimes that pollute Boston

harbour. The rain water becomes acidic due to coal burning plants in Ohio, United States.

Overflow in the sewers occurs due to rain and it directly flows into river Charles and

Boston harbor. Taylor addresses the place of toxic dumping between the Spectacle Island

and South Boston as "the address of the crime" (Stephenson, *Zodiac* 121). Stephenson

explains in this novel that Boston Harbor has been dumped by wastages for nearly three

and a half centuries. The total technological crime of corporate companies lies in the

Boston Harbor.

During Taylor's project, he comes to know about Basco industries, the major

producer of Agent Orange, a herbicide. It is a mixture of two different herbicides 2, 4-D

and 2, 4, 5-T. The presence of dioxin makes Agent Orange hazardous. It belongs to the

class of polychlorinated dibenzodioxins, which is similar to (PCBs) polychlorinated

biphenyls. Taylor explains that "The toxic part is the chlorine" (Stephenson, *Zodiac* 132).

The chlorine in the salt is in ionic form whereas the covalent chlorine is very reactive and

can easily dissolve in the fat.

Taylor utters that "The difference between that and table salt is that table salt is

inorganic, ionic chlorine – soldiers without a boat, with no ammunition – and this other

stuff is organic, covalent chlorine – bad stuff" (Stephenson, *Zodiac* 133). The wastages of

corporate companies which have covalent chlorine are considered to be toxic for all the

living creatures. The presence of poisonous chemicals in artificial herbicides and pesticides affects the nature of the natural environment. The toxin in Agent Orange remains for decades and causes cancer; birth defects; and nervous, respiratory and circulatory problems. The soldiers and people in the Vietnam War, who are exposed to Agent Orange, are affected by these serious health issues. The Agent Orange Act was passed in1991 to analyze the health defects due to its usage during the Vietnam War.

The owners of corporate companies are using technology in their industries to hide their faults from the eyes of the public. The illegal activities of the corporate companies are dumping old transformers deep inside the harbor, releasing toxic dioxin and covalent chlorine in harbor water, and creating new bugs to eradicate PCBs from harbor. All these illegal activities are responsible for the environmental pollution. The industrialists forget that they too live in the same polluted environment. Boston harbor has been polluted for nearly three centuries and it takes more than thirty years to clean it up. The upgradation of technology in this novel, like the toxic eating microbes, with complete research is appreciable.

In this novel, human beings' interaction with technology on the destructive side gives way to water pollution. The corrupted mind of the corporate companies is responsible for the environmental deterioration. Humanity among the corporate companies are stewed and witted. Once the result of using some technology goes to the destructive side, it should be altered and a proper solution should be found to restore the loss. The advancement in technology is appreciable and at the same time, the technological wastages have to be disposed in a proper way.

Industrialization results in building large factories and in producing more goods. It replaces the earlier forms of work and lifestyle of people. Industrialization has many good things like production of goods, increase in wealth and good standard of living. On the other hand, it increases urbanization. The natural way of doing agriculture is replaced by using artificial herbicides and pesticides, which contaminates soil and water. It also results in health issues for human beings and other living creatures. In *Zodiac,* human beings adapt technological tools, machines and chemicals to increase production and to do things easier and faster. This adaptation of technology in daily life to extend the abilities makes human beings as cyborgs. They are the producers and operators of machines. In this novel, technology is being adapted by industrialists, researchers and common people of Boston. The lack of complete research in the invention of new bugs to eradicate toxins paves way for hazardous effects. The proper knowledge and handling of technological tools will lead to a good and safe environment. Thus human beings become cyborgs when they depend too much on machines and technologies for the betterment of life.

Snow Crash is the next novel taken for analysis. This novel covers many subjects like anthropology, history, linguistics, computer science, cryptography and philosophy. Neal Stephenson depicts the possible near future more than two decades ago. The Board of Regents in the University of Wisconsin System explains that "Neal Stephenson dealt the genre a killer blow with his virtual swift sword in *Snow Crash* (1992)" (319). The imaginary technological enhancement and its positive and negative effects are discussed in the study.

This novel paves way to explore the imaginary growth of technology and its consequences. The pizza delivery system mentioned in the novel has advanced technology. The address can be taken from the phone number of the customer and it is saved in the system. It is sent to the car which calculates and projects the route of the address on the display. The pizza should be delivered within the given time because the traveling time has been calculated already through the distance. The delay in delivery is explained in the novel as "If the thirty minute deadline expires, news of the disaster is flashed to Cosa Nostra Pizza Headquarters and relayed from there to the customer" (Stephenson, *SC* 4). This can prevent any trouble or problem during the delivery. Everything is keenly observed by the CosaNostra, the pizza company through video recording. It is explained as "all of this is going onto videotape. The tape is being pipelined, as it happens, to CosaNostra Pizza University, where it will be analyzed in a pizza management science laboratory" (Stephenson, *SC* 10). These videos are shown to the students of Pizza University as an example. The frontier technology used in pizza delivery systems shows the growth of technology in a constructive way.

Information transmission becomes very easy through technology. Hiro collects information in the form of video, audio, fragments of computer disk, gossip, document Xerox or even a joke. This can be changed into machine readable form and sent to the Central Intelligence Corporation of Langley which is merged with the Library of Congress. Hiro gets paid only when the information is useful. Technological growth makes people pass and get information within a fraction of second. The importance of information and the role of technology in passing it are explained as:

The inevitable final step – similar devices implanted in our own bodies, monitoring the world, communicating with other such devices, and enabling us to manage, recognize, store, and compare information quite effortlessly as we go about our daily business. A vision of a world in which information is more available to all of us, no matter where we are, whenever we need it. Such technologies, to support the kind of profound integration into human life here envisaged, need to be just about maximally nonopaque. (Norman 59)

Neal Stephenson explains the destructive side of misusing digital inventions like mind hacking and digital forms of virus effectively. People find some relaxation in the virtual world by disconnecting themselves from reality. Hiro often enters the virtual world called Metaverse and it is explained that "He's in a computer-generated universe that his computer is drawing on to his goggles and pumping into his earphones" (Stephenson, *SC* 22). Metaverse has everything as in the real world except the laws, government and death. People inside Metaverse are the software pieces in the form of avatars. They can take any form as they want to look like, beautiful or ugly, fat or lean and tall or short.

People can roam around the Metaverse in the form of Avatar. The physic of avatar can be in anyform according to the user. Unlike reality, "if you've gotten out of bed, your avatar can still be wearing beautiful clothes and professionally applied makeup. You can look like a gorilla or a dragon or a giant in the Metaverse" (Stephenson, *SC* 34). The avatar of Hiro looks like him. The only difference is that no matter what Hiro wears in reality, his avatar always wears black color leather. Hiro lives more time in Metaverse than in reality. The Metaverse also has monorail facility. The monorail track has been

running down the middle of the street. "Monorail is a free piece of public utility software that enables users to change their location on the Street rapidly and smoothly" (Stephenson, *SC* 25). This monorail inside the Metaverse allows people to travel from one place to another through streets rapidly and smoothly. Hiro and his friends like to write software for cars and bikes in order to move around the Metaverse.

In Metaverse, Hiro is offered a file called Snow Crash but he has not heard the name so far. He assumes that it can be linked with computers. He says that "It means a system crash – a bug – at such a fundamental level that it frags the part of the computer that controls the electron beam in the monitor, making it spray wildly across the screen" (Stephenson, *SC* 39). The same black and white person in the Metaverse has offered Da5id a hypercard. Initially Hiro warns him not to open because it can contain any harmful virus. But Da5id laughed at him and said he has got so much contaminated stuff like this from many hackers. Da5id said working in his system is like "it's like working in a plague ward" (Stephenson, *SC* 67). Later Hiro is informed that Da5id is admitted in hospital and they put him on a temporary pacemaker. The doctor says "he's got such bad cardiac arrhythmia" (Stephenson, *SC* 176).

Hiro takes Da5id's googles which are on the floor and looks through it. He identifies that Da5id's computer is affected by Snow Crash and he can see the black and white wall on the monitor. Stephenson brings many more hackers in a single novel unlike Gibson who has coined the term 'cyberspace'. Gibson uses a single hacker in his writings, whereas Stephenson depicts distribution of networks in his *Snow Crash*. An article in *Contemporary Literature* comments:

Stephenson's work, however, does two things that Gibson's does not. First, it

provides a historical account of the emergence of that society from the military

deployment of cybernetics during World War II (*Cryptonomicon*). Second, it

documents the transformation of human subject from an independent operator

(Gibson's lonely hacker) into a fully networked and distributed agent, able to

write software and, with others, script new cybernetic worlds (*Snow Crash*).

(Youngquist 329- 330)

The digital form of the Snow Crash virus looks like a series of binary information

which appears as a bitmap image full of black and white pixels. It is explained that

"The virus that ate through Da5id's brain was a string of binary information"

(Stephenson, *SC* 329). The black denotes one and the white denotes zero. Not only

Da5id's system software is poisoned by Snow Crash but also his brain. Jaunita explains

that "Da5id had a snow crash last night, inside his head … That digital information was

going straight into Da5id's optic nerve" (Stephenson, *SC* 186). She further explains that

when the system gets affected by a virus like Snow Crash, the system flashes with zeros

and ones with huge digital information. This digital information enters the brain through the

optic nerve so that the person's brain stops working.

Lagos, a hacker, tells Hiro that Raven is a very dangerous person and asks Hiro

not to mess with him in Metaverse and also in real life. He further states that hackers

have deep structures to worry about when the Snow Crash affects the brain. He elaborates

the defenseless stage of hackers as:

You were forming pathways in your brain. Deep structures. Your nerves grow

new connections as you use them – the axons split and push their way between

the dividing glial cells – your bioware self-modifies – the software becomes part

of the hardware. So now you're vulnerable – all hackers are vulnerable – to a

nam-shab. (Stephenson, *SC* 117- 118)

Nam-shab is like a magical spell that hacks the mind of people. It is explained that

"*A speech with magical force*" (Stephenson, *SC* 197). In ancient times God Enki used this

nam-shab to change the neurolinguistic nerve of the brain. This nerve helps to understand

the abstract of the people's language. Initially all the people spoke only the Sumerian

language. This language was used in Mesopotamia till 2000 BC. It is considered to be the

oldest of all the languages in the world. God Enki makes Sumerian language to disappear

from the people's brain through the incantation nam-shub. So that the people start to

speak different languages and one cannot understand the other. Enki knows to control the

brain and the language by understanding the connection between brain and neurolinguistic

nerve. Enki is considered to be an ancient Sumerian brain hacker who used language as a

type of technology. The librarian says that "It just vanished, like the dinosaurs"

(Stephenson, *SC* 203). This gives way for various languages of the world. The librarian

further explains that "There is no provable genetic relationship between Sumerian and

any tongue that came afterward" (Stephenson, *SC* 196). This is similar to The Tower of

Babel in The Bible. The Snow Crash has the same power to hack the neurolinguistic

nerve of the brain as nam-shab does. This is said to be "digital nam-shabs" (Stephenson,

SC 259). The Metaverse is full of codes, which make computers understand. The librarian

says that "The Metaverse in its entirety could be considered a single vast nam-shub,

enacting itself on L. Bob Rife's fiber-optic network" (Stephenson, *SC* 197). Rife has strong belief in nam-shab and so he uses technology as a tool to spread viruses for hacking the brain of human beings.

The librarian is comparing both the physical form of Snow Crash and the digital Snow Crash. He explains that "If there was some *phenomenon* that moved through the population, altering their minds in such a way that they couldn't process the Sumerian language anymore. Kind of in the same way that a virus moves from one computer in the same way" (Stephenson, *SC* 203- 204). Both viruses have the same function of hacking the brain but in different forms.

Librarian explains the digital virus as "He also has a digital metavirus, in binary code, that can infect computers, or hackers, via the optic nerve" (Stephenson, *SC* 378). The physical form of Snow Crash which has been spread through the blood is equal to an illegal steroid because it enters the cell wall of the human body and affects nucleus as steroid does. It is said that "Snow Crash is a roid. Or else it's similar to a roid. Yeah, that's it. It goes into your cell walls, just like a roid. And then it does something to the nucleus of the cell" (Stephenson, *SC* 233). The invention of the virus like snow crash shows the darker side of technological growth. Selfishness of Rife makes technology to travel towards the side of destruction. Rife and Raven, are responsible for the spreading of viruses. The sufferers of those viruses are the hackers and the common people.

Neal Stephenson compares the biological virus with Goddess Asherah, who is considered to be "a carrier of a viral infection" (Stephenson, *SC* 215). Goddess Ashera had different stories in different cultures. In Akkadian culture, she was called Ashratu, and considered as a chief deity of Babylon. In Hittite culture, an Indo-European culture,

she was named as Asherdu. She was the wife of God Elkumirsa, a storm God.

In Ugarit culture, a Syrian culture, she was represented in the name of Athirat Yammi

and she was consort of God EI. In this culture, she was worshiped as Sun Goddess.

In Mesopotamian culture, she was known as Elat or Qodesh, which represents holiness.

In Egyptian culture, she was standing on a lion and holding two serpents in hands.

The worship of Goddess Asherah includes cult prostitution. There would be a chance to

spread virus through the bodily fluids. People consider Asherah virus to be the most evil

one. Like Goddess Asherah, Rife wants to spread Snow Crash among people but he does

not like to spread through cult prostitution because it is against his religion. So he starts

to vaccinate through needles. He takes the infected virus from other people and packs it

under the name of Snow Crash. He also programmed a cyber virus named Snow Crash to

hack the brain of human beings. It is in the form of a file, when a person opens the file

which has Snow Crash on the computer, his brain will be affected in real life. Both forms

of virus have been spread through different ways with the same aim. The technologies in

most of the fields are used for the betterment of people's life but there are also certain

incidents like spreading of virus and hacking that affects people both physically and

mentally. Andy Clark explains the impacts of technological addiction as:

> People predict a kind of technologically incubated mind-rot, leading to loss of
>
> identity, loss of control, overload, dependence, invasion of privacy, isolation, and
>
> the ultimate rejection of the body. And we do need to be cautious, for to recognize
>
> the deeply transformative nature of our biotechnological unions is at once to see
>
> that not all such unions will be for the better. But if I am right – if it is our basic
>
> human nature to annex, exploit, and incorporate nonbiological stuff deep into our

mental profiles – then the question is not whether we go that route, but in what ways we actively sculpt and shape it. By seeing ourselves as we truly are, we increase the chances that our future biotechnological unions will be good ones. (Clark, Natural 198)

Despite of all the above mentioned disadvantages, Andy Clark hopes for a better technological future. Katherine Hayles calls this as "post-human future" (29).

In this novel, the body of Ng, a character, has too many implantations because of a severe accident. He uses Freon, a colorless and odorless gas, to maintain a particular temperature for the proper functioning of the implanted organs. Freon is used in refrigerators and air conditioners to maintain low temperature. Ng is introduced as "he is the biggest chill wholesaler/retailer on the West Coast… air conditioner is a part of Ng's body" (Stephenson, *SC* 315). He is considered to be a cyborg as he has physical implantations. Y.T., who uses 'dentata', an anti-rape device, wonders the heavy utilization of Freon by Ng. She says that "Ng's van is air-conditioned. Not with one of those shitty ozone-safe air conditioners, but with the real thing, a heavy metal, high capacity, bone-chilling Frigidaire blizzard blaster. It must use incredible amount of Freon" (Stephenson, *SC* 313). Though Ng cannot do the works by himself, he has utilized technology to the core to do his works by himself. The other characters in the novel like Hiro, Y.T., Da5id, Librarian, Rife, Raven are also considered to be cyborgs as they get adapted to the technological advancements mentally. Both human beings and technology grow hand in hand together. Thus technology has become an indispensable element of human life, which transforms human beings as cyborgs.

The third novel *The Diamond Age* explains the near future of the world, where nanotechnology has developed and buildings are constructed cheaply. It is a coming-of-age story, focusing on a young girl named Nell. She is from thete, a community, living with her brother Harvard and mother Tequila at a lowland slum called Leased Territories. A thete is a person who does not belong to any tribe. It is considered to be the lowest working class. The buildings on the Leased Territories are built by artificial diamondoid located near the mouth of river Yangtze, which is also mentioned in Stephenson's *Cryptonomicon* as "A Yangtze River Patrol gunboat is tied up there" (Stephenson, *Cryptonomicon* 1- 2). Nell's name is also depicted in Charles Dickevision's work. The name of the protagonist in Charles Dicken's *The Old Curiosity Shop* (1840) is Little Nell.

In this novel, the story posits a future where nanotechnology occupies a prominent role in society. It portrays the mixture of both good and bad things. It depicts the interaction of human beings with technology like nanotechnology. The development and advancement of nanotechnology in the future is well predicted in the novel by Neal Stephenson. Nanotechnology is used in all fields of daily life and sometimes it saves nature.

Neal Stephenson has woven this plot with landscape, tradition, culture and nanotechnology. In an article, "Applications of Nanotechnology in Daily Life", the nanotechnology in the environment is explained as "decreased harm to the environment, as well as offering environmental remediation" (Nasrollahzadeh 113). Nanotechnology does not produce harm and has been used as an environmental remediation. Thus nanotechnology is explained as:

Nanotechnology is the science and technology of very small things in particular,

things that are less than 100 nanometers in size. One nanometer is one billionth of

a meter. A human hair is about 50,000 nanometers wide. Nanometer is a special

point in overall length scale because it is the junction where the property of

material changes as their size approaches the nanoscale. The interesting and

sometimes the unexpected properties of nanoparticles are due to the large surface

area of the material. At this size scale, everything, regardless of what it is, has

new exotic properties and these make "Nano" so fascinating! (Khanam 90)

Khanam explains that the measurement of one nanometer is a billionth of one

meter. He further says that the material's property gets changed when its size reaches the

nanoscale. Sometimes the properties of nanoparticles depend upon the surface area of the

material. He says these things make Nano very interesting.

Neal Stephenson focuses on technology, especially nanotechnology to figure out

the advanced world. The technological ideas in the novel are the representative of Neal

Stephenson's innovative and creative writing. The technologies that have been explored

in the novel like Primer and Matter Compiler are programmed with the help of

nanotechnology. The electronic book, the Primer, teaches the girl children to be brave

and to act as a resistance against evil things.

Matter Compiler is merely like a 3D printer in an advanced and user friendly way.

People can get anything through a matter compiler. They make food items, clothes and

other necessities of life. They are also kept in the public place for the sake of poor people.

This matter compiler works with nanotechnology. The mites, which are also called as

Nano-drones, are pictured in the novel as it can do anything like looking for something

on the streets, searching for things, acting as an artificial immune system by cleaning the toxic microbes from the body and crawling up and down in the nervous system that functions as a torturing device for nefarious activities in the police department. Stephenson posits the positive way of utilizing technology and a healthy society as its result.

In the current scenario, nanotechnology becomes remarkable in the applications of industries and its growth. The contribution of nanotechnology in the modern period is portrayed as:

> For example, in the pharmaceutical communities of practice, nanotechnology has had a profound impact on medical devices such as diagnostic biosensors, drug delivery systems, and imaging probes. In the food and cosmetics industries, use of nanomaterials has increased dramatically for improvements in production, packaging, shelf life, and bioavailability. Zinc oxide quantum dot nanoparticles show antimicrobial activity against food-borne bacteria, and nanoparticles are now used as food sensors for detecting the food quality and safety. Today, nanotechnology impacts human life every day. The potential benefits are many and diverse. However, because of extensive human exposure to nanoparticles, there is a significant concern about the potential health and environmental risks. These concerns led to the emergence of additional scientific disciplines including nanotoxicology and nanomedicine. (Hulla 1319)

In the pharmaceutical industries, nanotechnology plays a very good role in the medical devices like biosensors, drug delivery systems and imaging probes. Biosensor is an analytical device, which is used to detect chemical substances that combine with a

biological component. This instrument has been used from medical to agricultural fields. Drug delivery system (DDS) is referred to as a device or formulation that enables the introduction of a therapeutic substance into the body and improves its efficacy.

Nano materials are used in the food and cosmetics industries to increase the production, package, shelf life and bioavailability. The quality and safety of the food items are detected through the nanoparticles. Zinc oxide quantum dot nanoparticles are the most common and widespread nanomaterial in use. These nanoparticles are seemed to be safe for human beings. In an article, the energy of Zinc oxide quantum dot nanoparticles is described as "A small dielectric constant in ZnO leads to very large exciton binding energies" (Fonoberov 19). These nanoparticles act as against food spoiling bacteria. The potential benefits of using nanoparticles are many. Due to wide usage of nanoparticles, the health and environment have to be concerned. These concern heads towards the emerging disciplines like nanotoxicology and nanomedicine. Nanotoxicology is a branch of toxicology. It is the study of toxicity of nanomaterials. It determines the relationship of structure and function between the nanoparticles and toxicity. Nanomedicine is a branch of medicine. It uses the tools of nanotechnology to prevent a disease and gives treatment for the disease. Nanomedicine involves the use of nanoscale materials in the treatment.

In the beginning of the novel, Stephenson narrates the use of nanophone by Princess Charlotte. It is depicted as "a nanophone was hidden somewhere in the lace collar of her pinafore, tied into the top layers of the island itself" (Stephenson, Diamond 16). The nanophone is used by Princess Charlotte during her birthday party on a beautiful island. She uses it to make her speech audible to the guests. She hides it in her dress.

The audience does not identify the presence of nanophone with her. Stephenson has also mentioned that the nanophone is used by Miranda during racting. It has been placed near her gums in order to make her voice louder. Nanophones are used to produce a louder voice while delivering something to a group of people.

Finkle-McGraw explains his autobiography that he has left University without getting a degree and has started to do agriculture. After his mother's death, he moves to Minneapolis and starts working in a company which has been founded by one of his professors. His work is to scan tunneling microscopes. His interest and competence in the field of nanotechnology gets increased and he is noted as one among the few hundred pioneers of nanotechnological revolution. His self-confidence and intelligence paves way for his success of his own company, which has been founded after five years of moving to Minneapolis. It is described as:

> But it was a perfect for a man who wanted to study nanotechnology, and Mcgraw
> began doing so, working late at night on his own time. Given his diligence, his
> self-confidence, his intelligence ("adaptable, relentless, but not really brilliant"),
> and the basic grasp of business he'd picked up on the farm, it was inevitable that
> he would become one of the few hundred pioneers of nanotechnological
> revolution. (Stephenson, *DA* 21)

Stephenson explains the society where nanotechnology occupies a predominant place among the people. He posits that "Now nanotechnology had made nearly anything possible, and so the cultural role in deciding what should be done with it had become far

more important than imagining what could be done with it" (Stephenson, *DA* 37).
The possibility of certain things in culture becomes a necessity due to the development of nanotechnology.

Stephenson explains the office of McGraw where nanotechnology is deep rooted. He explains the usage of nanomanipulator and molecular nanophenomenoscope at McGraw's office. Nanomanipulator is a nanorobot with a microscopic viewing system. It is designed to operate the nanoscale objects. The nanophenomenoscope is tied in an engineer's head for scanning the small particles. This is pictured as "scanning infinity" (Stephenson, *DA* 48). This nanophenomenoscope is used to analyse the deep perception of an object. Nanotechnology has been deep-seated in the industrial sector. Hackworth questions about nanoreceptors to Mr. Cotton while talking about smart makeup. Mr. Cotton explains that nanoreceptors are used in the smart makeup for changing the texture of the skin. He explains this as "Word has it they considered makeup with nanoreceptors for galvanic skin response, pulse, respiration, and so on" (Stephenson, *DA* 52). These are some of the advancements in the nanotechnological field which make closer interaction among people and technology.

Stephenson has pictured the use of nanobar wrapper. Harv has used nanobar wrapper in order to get free from the dust. To get dust free air Harv gets up in the morning and "tied a strip of white nanobar around his face" (Stephenson, *DA* 61). This white strip nanobar is covered in a nanobar wrapper. Stephenson has also mentioned about the nanotechnological rice production. Hackworth has been thinking about the Nipponese' "way to generate passable rice (five different varieties yet!) direct from Feed" (Stephenson, *DA* 80). Nipponese have some suggestions among the experts in the field

regarding the same. Hackworth explains this process as "nanotechnological rice production" (Stephenson, *DA* 80). The rice production through nanotechnology is compared with the tooth paste and the tube. It is depicted as "polymers and nanotechnology went together like toothpaste and tubes" (Stephenson, *DA* 80). Stephenson has used nanotechnology in each fragment of the story.

Nanotechnology occupies an important place in the manufacturing process of the Primer. The process involves very minute mechanisms. The initial phases of growth in the Primer are explained as:

> In the beginning was an empty chamber, a diamond hemisphere, glowing with dim red light. In center of the floor slab, one could see a naked cross-section of an eight centimeter Feed, a central vacuum pipe surround by a collection of smaller lines, each a bundle of microscopic conveyor belts carrying nanomechanical building blocks-individual atoms, or scores of them linked together in handy modules… It surveyed the microscopic world through X-ray diffraction, electron microscopy, and direct nanoscale probing, and synthesized all of the resulting information into a single three-dimensional view. (Stephenson, *DA* 65-73)

The process involves a very minute mechanism for the betterment of the book. Hackworth is a programmer, who is profoundly involved in its making. Runcible is the program with a number of subprograms in it. The three dimensional view of the Primer is due to the X-ray diffraction, electron microscopy and the nanoscale probing. The nanotechnological implementations in Primer give good education for the girl children, which results in societal change.

Stephenson explains the function of nanostructures in the airship. The nanostructures help to evacuate the hot air, hydrogen and helium which are flammable from the airship. The modern airship does not fill those things due to the functioning of high strength nanostructures. It is exposed as "High-strength nanostructures make it possible to pump all the air from an airship's envelope and fill it with a vacuum" (Stephenson, *DA* 122). The nanotechnology is also used in the police department to bring out the truth from the criminal. Nanosites are used as a torturing device in order to drag out the reality to the lime light. When the nanosites are attached to the nerves, it feels like someone is tickling. The movement of nanosites inside the spinal card makes to feel very disturbed. The nanosite can attach itself to the nerve running from the ear drum into the brain. Introducing nanosites into the nerves and its function is explained as:

> The attachment of the nanosites to the nerves is an aleatory process – we never know which nanosite will end up where. The sensations you are experiencing noe are a way for us to take inventory, as it were. Of course, nothing is actually happening in your thigh or foot; it all takes place within the spinal column, and you would feel it even if your legs had been amputated. "That's really weired," PhyrePhox exclaimed, his pale green eyes going wide with amazement. "So you could even, like, torture a basket case." His eye and cheek twitched on one side. "Damn! Feels like someone's tickling my face now. Hey, cut it out!" A grin came over his face. "Oh, no! I'll tell you everything! Just don't tickle me! Please!" (Stephenson, *DA* 140-141)

The nanotech warfare is also brought into the story line of this novel. Constable Moore, Nell's guardian in Dovetail, is a defense officer. Though he is retired, he often goes for warfare. He has pinned many batches in his uniform which remains his various levels of grades. He has acquired training in nanotechnological engineering, which takes him to nanotech warfare. This is explained as "One of the pins on the Constable's uniform said that he had graduate-level training in nanotechnological engineering. This was consistent with his belonging to the Second Brigade, which specialized in nanotech warfare" (Stephenson, *DA* 279). Stephenson depicts nanotech has been introduced in the defense department before thirty years of Nell's arrival to dovetail. Nanotechnology in warfare belongs to the nanoscience department. The nano molecular systems are intended and created to fit within the nano scale. The applications of nanoscience in warfare result in the research context of manufacturing weapons. The advancement in nanoscience results in various nano weapons like small robotic machines, explosives with hyper reaction and electromagnetic super materials. The impact of technological growth gives rise to issues concerning safety of the society, global security and the environment. The law has to be monitored constantly in order to keep dynamic development in nanoscience due to certain dangers of using it.

Dr. X explains the destruction of nature due to technological implementation in the society. Matter compiler provides food items with the help of nanotechnology. It replaces the natural food items provided by the peasants. The culture of matter compiler has been imported from the western countries. This paves way for the

destruction of the society because the society is completely based upon planting.

He further says, in a healthy society, the production has to be higher than consumption.

The missing of nature due to the interference of technology in the society is depicted as:

> We have lived by the Seed for five thousand years, Dr. X said. He waved his hand
> toward the window. "These were rice paddies before they were parking lots. Rice
> was the basis for our society. Peasants planted the seeds and had highest status in
> the Confucian hierarchy. As the master said, 'let the producers be many and the
> consumers few.' When the Feed came in from Atlantis, from Nippon, we no
> longer had to plant, because the rice now came from the matter compiler. It was
> the destruction of our society. When our society was based upon planting, it could
> truly be said, as the master did, 'Virtue is the root; wealth is the result.' But under
> the western *ti*, wealth comes not from virtue but from cleverness. So the filial
> relationships became deranged. Chaos. (Stephenson, *DA* 457-458)

Stephenson explains that the devastation of nature is due to intrusion of
technology. He explains through the character of Dr. X that wealth is the result of virtue.
But the western saying states that wealth is the result of cleverness but not from virtue.
This paves way for the imbalance in the family relationship and disorder in the society.

In this novel, nanotechnology plays a prominent role in all the disciplines of the
society. Through the technologies that are presented in the novel, Stephenson is trying to
uplift the society from ignorance and poverty. The transformative technologies like mites,
matter compiler and Primer reach people and make changes in the society. Nanotechnology
is rooted in all the fields and its advancement has some good cause as well as bad cause.
It uplifts the life of young orphan girls, common people and extracts truth from the

criminals. The bad cause is that the technology has spoiled agriculture by producing artificial food items in the matter compiler. Due to lack of farming, all the lands are converted into parking areas and tall buildings.

In this novel, nanotechnology is utilized for the welfare of human community in the name of technological advancements like Primer, matter compiler, chevaline and smart paper. All these technological developments improvise the life of human beings. The characters in the novel like Nell, Elizabeth, Fiona and other orphan girls depend upon Primer, a nanotechnological cyber book to educate themselves. The people of Lessed Territories, who are poor, utilized matter compiler to fulfill their daily needs artificially. People also used chevaline, an artificial horse like vehicle to transport faster. These technological devices are considered to be the extension of the physical self and the mental self. Thus the characters' interaction with all these nanotechnological devices in the novel makes them as cyborgs. They can learn easily, get things faster and connect people quickly with these technological developments.

Cryptonomicon is the fourth novel taken for the study. The story of this novel takes place during World War II and 1990s.It explores the code breaking system of World War II and the hacking culture of the modern period. A fascination towards numbers is explained throughout this novel. A cryptographer must be good at Mathematics in order to make and break the codes. Throughout this novel, number games are discussed in many aspects. The characters look at everything from a mathematical perspective.

During the Second World War, the three wheeled Enigma machine of Axis powers was cracked by the Allied powers. Poland, which belongs to Allied power, knows to break the code of three wheeled Enigma so the German navy has designed a new four

wheeled Enigma machine. Through this they can send secret messages and information. When the German U-boat was wrecked, the allied power got a box for the four wheeled Enigma machine. The reality is that they do not know to operate the advanced Enigma machine. It is pictured as:

> They discovered an Enigma box with niches for four – not three – wheels. When the four-wheel Enigma had gone into service on February 1st, the entire Atlantic had gone black. Alan and the others have been going after the problem very hard ever since. The problem is that they don't know how the fourth wheel is wired up. (Stephenson, *Cryptonomicon* 202).

The information passes very fast and without the Enigma machine, it is risky to transfer secret messages and orders among the military circle. Alan while talking exposes that "A kingdom ruled not by men but by information" (Stephenson, *Cryptonomicon* 180). During World Wars, information occupies a major role. Everyone is seeking to know the secrecy of the opponent military. The information can be passed quickly through technology. Enigma is used to transfer information but by using the same technology the information can be cracked by the opponent party. The information is tracked through spying or code breaking. Spying of German is pictured as "German spy up in the rocks with a pair of binoculars" (Stephenson, *Cryptonomicon* 316).

Waterhouse is an expert in code breaking and the major asks him that "You're supposed to be some expert codebreaker, right?" (Stephenson, *Cryptonomicon* 578). The technological enhancement turns the war into an information war. Encoding and decoding the secret messages make the opponent to be aware of the secret information which turns the war very tragic. Cryptography in the military sector helps to protect their

own country by corrupting or destroying the enemy's secret information. Unlike physical attacks in the ancient wars, the present military takes information attacks in hand to defeat the opponent. The wars during the ancient period centered upon the organization whereas the modern wars center on technology.

At present, due to technological enhancement, cyber warfare becomes very common instead of the ancient style of war. Ancient wars were physical attacks, bombs and firefights. Cyber war uses digital attacks on a country to damage the information networks by cyber weapons like viruses, phishing, computer worms, malware and hacktivism. These cyber weapons become viable tools of the war. Viruses are the codes that infect the core files or applications in the system. It can spread from one system to the other. Phishing is the deceitful practice of tricking a person to reveal his personal details. They will mislead a person by sending emails declaring that they belong to a reputed company. Computer worm is like a malware that spreads and replicates itself independently from computer to computer. Malware is a software written intentionally to attack a computer network, server or to gain access to information or system. Hacktivism is breaking the codes of a system or application illegally using computer codes and techniques. The hacker can hack into a system and steal the data, which is called data theft. They can make use of the data or destroy the data permanently. Cyber war harms or disrupts the actual war or computer systems.

The characters in this novel are very much fascinated in mathematics and they use it to achieve their goals. Lawrence Waterhouse's love for mathematics plays a major role in his career. His interest in mathematics helps his teacher in fixing church organ. "Lawrence, who helped him open up the hood of the thing" (Stephenson, *Cryptonomicon* 7).

Later he shows much interest in learning tricks of using numbers. During his studies in Princeton University, he had friendship with Alan Turning and Rudy von Hacklheber. They used to discuss the way of using mathematics to build computers and code machines. His knowledge in Mathematics makes him an expert in cryptology. Randy Waterhouse is also very much interested in mathematics like his grandfather. He depends upon mathematics while hacking computers. When Randy and Enoch Root are in prison, they communicate through numbers secretly. In this novel, mathematics is used by the allied powers for code breaking and also to rediscover the hidden treasure during the World War II. Cryptography is used both as a weapon and an innovative tool. Mathematics is a basic tool for cryptology.

Randy and Amy, the characters from the 1990s period, talk about converting gold into digital money. Randy has an idea of exchanging gold through online. This prevents them from getting in any trap of the government in future. Randy further says that sound knowledge in cryptology can help to earn a lot of money and it would not hurt. It is depicted as "Better safe than sorry, I guess. Having good crypto can't hurt, and it might help. And it might make you a lot of money along the way" (Stephenson, *Cryptonomicon* 757). Exchanging the black money through paper might not be safe and it can be traced out easily. Through internet it can be done in the safest and fastest way. He explains this to Amy as:

> "Get a big pile of gold. Issue certificates saying 'this certificate can be redeemed for such-and-such an amount of gold.' That's all there is to it." … "The certificates-the banknotes-are printed on paper. We're going to issue electronic banknotes." "No paper at all." "So you can only spend it on the Net" … "Paper money is

traceable and perishable and has other drawbacks. Electronic banknotes are fast and anonymous."… "they look like any other digital thing: a bunch of bits". (Stephenson, *Cryptonomicon* 757)

Randy explains to Amy about his interest in cryptology. He doubts that it can be passed through genes from his ancestors. He does not know anything about his grandfather's knowledge on cryptology. He simply knows that he is a war souvenir by looking into a trunk of crypto materials. It is pictured as "I guess I have crypto on the brain. And, if there was some kind of connection between von Hacklheber and my grandfather-" (Stephenson, *Cryptonomicon* 600). The technology is very much developed in the current period while comparing with the period during the Second World War. Hacking and code breaking systems were there during the mid-twentieth century. In the modern period it has grown in many angles. This development of crypto culture is due to the involvement of human beings with technology. Amy asks Randy that in order to buy a banana from the vendor, she should have paper currency; digital currency becomes unworthy in this case. Randy replies "'What if you want to buy a sack of bananas?" "Find a banana merchant on the Net'" (Stephenson, *Cryptonomicon* 757).

Technology occupies a key role in the military innovations like airplanes, missiles, space crafts, tanks, drones, satellites, computers, GPS and so on. Mathematics is used as a tool to organize and structure the knowledge while applying with technology. It assists to improvise the technological operations throughout ages. In *Cryptonomicon*, Mathematics is used as a base for cryptography. The characters extend their mental self through cryptography by applying mathematics. The cryptography during the World War II

serves as a base for modern cryptography to encode and decode messages. Thus human beings became cyborgs when they started to use technology like cryptology in their communication.

Seveneves is the fifth novel taken for the study. This novel explains the survival of human beings around thousands of years in space after the destruction of earth. Human beings in space have undergone a lot of problems and troubles in order to survive. Stephenson has brought out a beautiful world again even after five thousand years of earth's destruction. The advancement in technology and its progress after thousands of years is analysed through this novel. The seven eves, the seven women who survived at last in space, developed a technology called parthenogenesis, to rejuvenate the human race.

In the novel, Moon is broken into seven pieces. People are afraid of those moon chunks which can destroy the earth. Doc Dubois, an astronomer and television personality, is observing keenly about the changes happening in the moon. He is the person to inform the American President Julia regarding the hard rain, the downpour of hard rocks on earth. Doc expresses the seven pieces of broken moon as seven sisters. He also gives names for each broken piece. He explains that "The moon had broken up into seven large pieces, which inevitably they became known as the Seven Sisters, and an uncountable number of smaller ones. Gradually the big ones acquired names… it was Potatohead, Mr. Spinny, Acorn, Peach Pit, Scoop, Big Boy, and Kidney Bean" (Stephenson, *Seveneves* 23). Stephenson has utilized his sociological imagination to bring out the advanced technological advancements.

Doc has hope that the humans can live in space and re-create human community. But the non-human living organisms are at the risky side. Human beings alone cannot regenerate the earth again. It is very difficult to rebuild the Earth with all the living organisms that exist at present. Some species are in the stage of their extinction. Doc likes to concentrate on the endangered non-human species. A simple and basic ecosystem can be created by growing algae, which can produce oxygen, a very basic for all the living organisms. It is explained as:

> If the Cloud Ark's as populous as they claim it's going to be, and if people come up with frozen sperm samples and ova and embryos and all of that, then the human population is probably all right. We'll have enough heterazygosity to make a go of it. My work here is going to be more concerned with nonhuman populations… we'll be growing algae as a way to generate oxygen. Which is only the start of a simple ecosystem that will have to be developed and grown, and become much *less* simple, over the years to come. Many of the plants and microorganisms that will make up the ecosystem will be cultivated from initially from small breading populations. (Stephenson, *Seveneves* 222- 223)

Scientists look forward to save the endangered Earth. They are using technology to build a space bound station suitable for living many generations. Human beings are already living in the technologically advanced world and the future generations are going to live a complete machine life in space due to Earth's destruction. Tavistock, a journalist and an information giver for the scientists, is working for Cloud Ark in space. He says that the human brains are already digitalized by living in the digitalized world. He says "we might all, in fact, be living in a giant digital simulation" (Stephenson, *Seveneves* 211).

The development in technology paves way to prevent the destruction of entire species of

the Earth by sending them to space. Doc says that the ultimate goal is not building space

stations and making human beings as space habitants, but to rebuild the earth in a better

way after thousands of years. He says that "The real goal is to build Earth again, and

build it better" (Stephenson, *Seveneves* 215).

Living in space is tough as people lived on the earth sophisticatedly. There are

restrictions for eating, drinking, sleeping and for everything. Due to lack of oxygen in

space, life becomes threatening for living organisms. It is depicted as "they'd been able to

make oxygen by splitting H_2O, and life had improved. Until then, however, they'd been

oxygen hungry and tense, trying to keep their consumption of air and food to a minimum

by floating listlessly in their sacks watching the same DVDs over and over again. Health

and mental status, had suffered" (Stephenson, *Seveneves* 395-396). In space, scientists

generate oxygen from water. They are allowed to eat only a minimum quantity to

maintain proper health in the space environment.

The scientists and researchers are doing research and trying to make the space as a

friendly environment for all the age groups. The Human Genetic Archive is destroyed but

before that the Earth has been completely destroyed. Doc explains this as "Human

Genetic Archieve had been almost completely destroyed… Seven billion people died

yesterday. Compared to that, the loss of some genetic samples is nothing" (Stephenson,

Seveneves 315). Though the Human Genetic Archive has been destroyed and all the

human population has died except eight women, they do not lose hope. Moira, a

geneticist, has the hope of regenerating the human population through parthenogenesis,

an asexual reproduction. An embryo can be formed without the fertilization by sperm.

During their research, they have identified a place above the Cloud Ark for getting sunlight for energy and agriculture. The scientists and people in space depend only on technology. They seek help from the robots for doing works like moving rocks, cleaning works and so on. Everything has computerized control system to maintain the works in a systematic way. They have a lot of stocks to change chips and tools which were brought from the Earth. This is depicted as:

> Sunlight for energy and agriculture could be had a short distance above them, high on the walls of crevasse… They were dependent in many ways, on digital technology. They could not long survive without robots to do work for them and computerized control system to keep the installation running. They had no ability to fabricate new computer chips to replace the old. But the Arkitects, anticipating this, had stocked them with a large surplus of spare parts that would last for hundreds of years if husbanded carefully. And they had plans for rebooting digital civilization later; they had tools for making tools, and instructions on how to use them when the time came. (Stephenson, *Seveneves* 549-550)

Moira encourages them that they can still produce offspring without sperm. Julia cannot produce babies due to past menopause. Moria can separate a cell, a sperm or an ovum and read its genome with the help of digital records of DNA. She describes the process of parthenogenesis as a virgin birth. An embryo can be created through a normal egg. Initially it is done only with the animals. All the offspring are genetically similar to their mother. All the babies of a mother look similar without any change. The exact

copies of the genes can be avoided through the process called automictic parthenogenesis. In the process of parthenogenesis, a few sets of babies are girls. Later, when she works on the Y chromosome, it can result in boy babies. Moira explains this process as:

> There is a process known as parthenogenesis, literally virgin birth, by which a uniparental embryo can be created out of a normal egg. It's been done with animals. The only reason no one ever did it with humans is because it seemed ethically dodgy… all the offspring are the same. Exact copies. To get some genetic diversity, we need to use something called automictic parthenogenesis. (Stephenson, *Seveneves* 552- 553)

In the natural process of reproduction, the natural recombination of DNA results in babies to look like father or mother but not exactly like them. Moira assures that she can work with genotypes and bring a little change in their appearance. Ivy said that her offspring has Alpha-thalassemia, a blood disorder which reduces hemoglobin production. Moira said that she has databases to identify the defects and work with that chromosome. She can identify those defects from an ovum and fix the defect before starting the process of parthenogenesis. The technological enhancements in the field of genetic engineering hit a solution for breast cancer and cystic fibrosis. Dinah, one of the seven eves, doubted that she might have cystic fibrosis, a genetic disorder which affects lungs, liver and digestive system. Julia also says that three of her aunt has breast cancer and she might also carry the same defect through gene. Moira replies that same answer is applied for both the cases. She further says that through genetic test, the defects which are responsible can be identified and cured. The defect can be altered in the chromosome before creating an offspring through parthenogenesis.

In this novel, technology holds an important position in rejuvenating the human race. Parthenogenesis, a method to produce the human race again without fertilization, is done in space to recreate the human population. Moira has done a lot of research to repair the genetic defects like cystic fibrosis, breast cancer and bipolar disorders. Human beings in space are considered as cyborgs due to their technological adoption. Seven eves and Julia act together with technology to save the human race and other species of Earth from a heavy disaster. Though there are lots of clashes among them, they united together with all those diversities and re-created life on Earth with technological assistance.

In all these five novels of Neal Stephenson, technology plays a major role. He has compiled the plots which are technologically rich in vision. He has prefigured certain technological concepts in his novels like social networking, nano robotics, 3D printers, Metaverse, virtual tutor and cryptocurrency.

In *Zodiac*, the production of Agent Orange is found to be dangerous in agriculture. In order to clear the PCBs emitted by transformers, new microbes are let out in the harbor. Though they swallow up the toxic elements, these microbes are eaten by the aquatic organisms which in turn again affect the food cycle of the living organisms in harbour. In *Snow Crash*, metaverse, the pizza delivery system, Y.T.'s skate board and dentate, an anti-rape device, Ng's implantations and Freon usage reveal the growth of technology which is a boon to humanity. At the same time, spreading of virus through metaverse is a bane to the society. This online game transforms human beings into cyborgs. In *The Diamond Age*, 3D matter compiler, 3-dimentional view of Primer, nano manipulator, nanobar, wrapper, nano rice, nano sructures in airship, nanosites, nanotech warefare, chevaline and smart paper scale the growth of technology. Eventually, the Seed

Project, which produces cheap narcotic drugs, is to be stopped. In *Cryptonomicon*, the Enigma machine and digital communication explain the advanced technology. In spite of it, they could not find the treasure hidden in the ocean. In *Seveneves*, Cloud Ark, Human Genetic Archieve and Parthenogenesis reveal the height of technology. At the same time, in the space, people do not have the freedom of living on earth. They always depend on oxygen cylinders.

Thus in *Zodiac*, the industrialists and researchers; in *Snow Crash*, Hiro, Y.T., Ng, Da5id, Librarian, Rife and Raven; in *The Diamond Age*, Nell, Elizabeth, Fiona, orphan girls and the people of Lessed Territories; in *Cryptonomicon*, Lawrence Waterhouse, Alan Turning, Randy, Enoch Root and Amy; in *Seveneves*, Dinah, Ivy, Julia, Moira, Tekla, Camila, Aida, Luisa and people of seven different races in the space are transferred into cyborgs.

It becomes very hard to remove technology from the life of human beings, who are very much integrated with technology. Human beings have developed an intimate bond with technology which results in turning them into cyborgs. The technological advancements and the new technological tools rearrange the patterns of life and the way of living in the society. The next chapter deals with the change occurring in the society due to the enhancement of technology.