CHAPTER III

MIND, SCIENCE AND ARTIFICIAL INTELLIGENCE
Shuzan held out his short staff and said: "If you call this a shorts staff, you oppose its reality. If you do not call it a short staff, you ignore the fact. Now what do you wish to call this?"

- Zen Koan.
CHAPTER III

MIND, SCIENCE AND MACHINES

3.1 Physics -- Matter is not the end

It is the popular notion that scientists seldom deal with such concepts as "mind". It stems from the belief that all the scientists belong to a group of thinkers whose ideology denies the existence of anything other than what can be termed as physical. To use the philosophical terminology, they are radical materialists or radical behaviourists. They believe that whatever exists is only physical. Hence they are physicalists or reductionists. A slight variant of this ideology states that individual identity of each human being can be traced to the composition of atoms and this has led to another variant which traces it in the cells. This line of thought, I am afraid, emerges from the faith in Classical physics [here I include even Einsteinian physics to contrast quantum physics]. Surprisingly over the years this current of thought has been neglected without much attention though some philosophers like W.V.O. Quine have accepted one form or the other of the above ideology.¹ Some of the contemporary thinkers of Quine have suggested that some position like Radical Materialism has to be accepted either because of the results of scientific experiments or of philosophical analysis.² Before going into the position of what I call as atomic notion emerging from Classical physics, I would like to reflect on Popper's criticism on materialistic versions for the reasons we shall see soon.
Popper in his *Self and Its Brain*, starts with a brief analysis of materialism and proceeds to the mind-body problem and then concludes his analysis of materialism. Interestingly Popper, in the course of his analysis, takes up J.B.S. Haldane’s refutation of materialism and attempts to reframe the arguments and refutes materialism or physicalism.¹

According to Haldane "...if materialism is true, it seems to me that we cannot know that it is true. If my options are the result of chemical processes going on in my brain, they are determined by the laws of chemistry, not of logic."² It is interesting that Popper chose this because Haldane himself retracted the argument some two decades later, telling *I repent an Error.*³ Moreover the line of argument that Haldane chose in the beginning has been methodically rejected over the years.⁴ By tracking down to Haldane, Popper clearly goes back in time. He goes back in time not to find a new chain of reasoning but only to reanimate the self-retracted and completely rejected the argument to prove his point. To do such a thing, especially against a strong philosophy like materialism, is suicidal. This is Popper’s first mistake.

During the argument, Popper conceives a sort of conversation between two people labelled as *Interactionist* and *Physicalist*. Astonishingly, Popper, a philosopher with a big reputation, to make Haldane’s argument suit his purpose, cites computing machine as an example of an entity which can work in accordance with the
laws of physics and logic! In addition to this, he introduces his "three-world theory" to prove this point. It is not clear what Popper means by the laws of logic, here, for, computers are electronic devices and they function strictly according to the rules of natural science and certainly not according to laws of logic. Even granting Popper that his argument is valid, I would like to pose a question. If a computer, at sometime in future [and at the present rate of advancement it is not at all impossible], writes a program on its own and manufactures computers then, to which of the three worlds do they belong? Certainly not to the world 3 and 2, for they are neither mind nor the producers of mind. To push a program written by the computer to world 1 and equate it with the program written by a human being would be totally unfair.

By committing these two errors, Popper, instead of refuting the arguments of the materialists, is only helping them. How? He is helping the very people, whom he wanted to refute by equating inanimate matter with the human beings. If the producers of both humans and computers are at the same level, it could be possibly argued by the materialistic philosophers, that both of them could be conceived to be at the same level too, if not now, atleast at sometime in future. What an astonishing turn around. I have dealt with Popper's attempt at the refutation of materialism at length because it shows clearly how even a knowledgable man like Popper, a man with equal knowledge of Philosophy and Science; could make a fundamental mistake in the side of Science. It adds further weight to Churchland's arguments. Moreover despite these two errors, I am afraid this is by far the best criticism of materialism advanced at recent
times. One more reason for my dwelling in this materialistic version is that it is one strong theory that lies implicitly and tacitly in the currents of classical physics and modern biology.

Advocates with what I called as atomist notion, are those who believe that there is nothing called mind, every so-called mental activity can be reduced to brain processes and moreover even such brain processes can be viewed only in terms of the particles that compose atoms. However these advocates do admit that each individual human being possesses an identity. What gives a particular person his individual identity? The answer is two-fold, either it is the very atoms that compose his body or his identity is dependent upon the particular choice of electrons, protons and other particles that constitute atoms.

Now I would like to pose a question: who makes the choice of particles or how the choice is made? I surmise that they in all probability are likely to appeal [and somewhat strangely] to Natural Selection. Both their answers are not acceptable, for two reasons.8

In the first place, there is a continual turnover in the material of any living person’s body. This applies in particular to the cells in a person’s brain, despite the fact that no new actual brain cells are produced after birth. The vast majority of atoms in each living cell (including each brain cell) - and, indeed, virtually the entire material of our bodies has been replaced many times since birth. The second reason comes from quantum mechanics and by a strange irony is, strictly speaking, in contradiction with the first! According to quantum mechanics, any two electrons must necessarily be completely identical, and the same holds for any two protons and for any two particles whatever, of any one particular kind. This is not merely to say that there is no way of telling the particles apart; the statement is considerably stronger than that. If an electron in a person’s brain were to be exchanged with an electron in a brick, then the state of the system would be exactly the same state as it was before, not merely indistinguishable from it! ...If the entire
material content of a person were to be exchanged with corresponding particles in the bricks of his house then, in a strong sense, nothing would have happened whatsoever. What distinguishes the person from his house is the pattern of his constituents are arranged, not the individuality of the constituents themselves."

However good the above explanations might be, the last sentence of it brings back the problem. If it is only a pattern that which distinguishes man from his house, then, the same type of question emerges: Can the constituents themselves club together to form a pattern or do the making up of a pattern requires an outside agency? I am afraid that not only the classical physics but even the Natural Selection and the anthropic principle⁹ are incapable of providing a satisfactory answer. To make the patterns, do we need the conscious agent? It is very difficult to answer. However the nearest answer to the questions of above sort is more and more likely to come from Quantum Physics, in the Scientists search for the Mind. We elsewhere mentioned that curiously enough it is the analysis and research on matter and materialism that has led to the discussions on consciousness and mind. In the wake of the direction in which Quantum Physics is progressing, this is not at all an unacceptable hypothesis. I am confident that the answer for scientists [who knows, it could be for philosophers too] lies only in Quantum Physics despite Albert Einstein’s declaration that "Quantum mechanics is very impressive. But an inner voice tells me that it is not yet the real thing. The theory produces a good deal but hardly brings us closer to the search of the Old One. I am at all events convinced that He does not play dice."¹⁰
If one thinks that it is an irony that Quantum Physics, supposed to be an attempt to describe the physical world, should lead to something that which is extra-physical, then, I would like to mention at the outset that Quantum Mechanics is full of strange things and ironical facts. If Quantum theory takes us to the consciousness or Mind, then what about matter? If both does exist, then, what is the relationship [if at all it exists] between Mind and consciousness? If consciousness or mind or spirit or however one calls it, then what is the status of physical reality, of which we are more sure than consciousness or mind? Can we come to the conclusion that the physical world exists only in our minds? There are other questions we will attempt to answer in our analysis of Scientists’ search for Mind or Consciousness.

Before going into Quantum theory, let us experience, for ourselves how strange and perplexing the quantum world can be. To illustrate this, let us imagine a lamp emitting monochromatic light, one photon at a time. Let us also place a half-silvered mirror, tilted at 45°, to the beam. After meeting this mirror, photon’s wave function splits into two, with one part reflected and another part continuing in the same direction. Again the wave function is peaked doubly and that peaks are widely separated, with one peak describing the photon reflected and the other describing the photon transmitted. As time progresses the separation between peaks becomes larger and larger and after an year two peaks of photon’s wave function will be over a light-year apart. Somehow, the photon has found itself to be in two places at once.
more than a light-year distant from one another. The formalism of quantum mechanics makes no distinction between single particles and complicated systems of many particles. If this is acceptable, then why don't we perceive two macroscopic bodies having locations at two places at once? I agree with Penrose that the present day quantum theory does not contain a satisfactory answer. Leaving that apart, the above description was a highly simplified version of an experiment to show how even at the fundamental level quantum world can be complex and puzzling.

Coming back to our central theme, what makes the quantum physicists search for something extra-physical? Doesn't such a search for extra-physical fall into the domain of metaphysics or mysticism? Jeremy Bernstein, a particle physicist, expresses apprehension that such relation of physics to mysticism (?) will lead, eventually, to the **Obsolescence of physical sciences**. If this is true, then are we correct in our perception that quantum mechanics is leading us to something beyond physics? Or if it is true that quantum physics is indeed taking us into the realm of metaphysics, will it not lead to the **Obsolescence of physics**, as Bernstein fears?

Let us take a different route to answer these questions, quite different from the usual ones. In classical physics, there exists an objective world *out there* and such a world evolves around a clear and deterministic rules. This is also the common sense notion and this objective world existing independent of ourselves holds good for Einstein as it did for Newton. Such a world is not at all affected by the way in which one looks
at it. Not surprisingly, only this view of the world lies at the background of the philosophies of the world and self. But with the advent of quantum mechanics -- a fundamental scheme of things that emerged from the observations of the discrepancies between the functioning of the world and description of it by classical physics -- everything seemed to be changing. One of the central figures of the Quantum theory, Neils Bohr and his group of followers [there are many, many scientists who belong to them] denied the existence of objective reality out there. Nothing is actually out there at the quantum level. Somehow reality emerges only in relation to the results of measurement. In this view, quantum theory is nothing but a mere calculational procedure.\(^\text{13}\) Although I don’t agree with Bohr’s views in this regard, it cannot be rejected completely too. Interestingly, and significantly enough, these ideas were one of the many starting points for the progress of quantum theory to the extra-physical and that too against the wishes of many of Bohr’s followers!

Now let us look how the quantum physicists look at the extra-physical or consciousness or mind and then proceed to discuss what made them hold such views and what made quantum physics to move out of physics.

Most surprisingly almost all the major physicists, contrary to the popular notion, accept this hypothesis and believe that quantum physics, by progressing further can reveal the secrets of Nature. For Max Plank, matter is an epiphenomena of Consciousness. Remember, Plank is the founder of quantum theory! “Consciousness”,

88
Max Planck says, "I regard as fundamental. I regard matter as derived from consciousness. Everything that we talk about, everything that we regard as existing postulates consciousness." Probably he anticipated the direction of quantum theory towards consciousness or mind or something extra-physical when he wrote the following: "Science ... means unceasing endeavor and continually progressing development toward an aim which the poetic intuition may apprehend, but which the intellect can never fully grasp." A Nobel-prize winning physicist, Wolfgang Pauli puts it this way: "From an inner center the psyche seems to move outward, in the sense of an extroversion, into the physical world... ." Another Nobel-prize winning quantum physicist Eugene Wigner says that it is impossible to give a description of quantum mechanical processes "without explicit reference to consciousness." Erwin Schrödinger, whose equations that almost triggered a revolution in science and is still being debated, openly declared that consciousness is something beyond physical body and it is the real substratum of matter. He considers consciousness as numerically one. He even argued that plurality of consciousness is Maya. Much need not be said on Einstein's views on God, Consciousness and mind, since they are well known. He even went to the extent of telling, "I cannot conceive of a genuine scientist without that profound faith ... science without religion is lame, religion without science is blind." Another physicist E.H. Walker speculates that "consciousness may be associated with all quantum mechanical processes ... Universe is inhabited by ... unlimited number of rather discrete, conscious, usually non-thinking entities that are responsible for the detailed working of the Universe."
Dr. Stromberg whose name was inscribed in the wall of fame for his outstanding contributions to science almost shakes the foundations of all physical sciences with the following words: "The most startling recent discovery, and for us the most important, is that beyond the physical world of matter and energy is another world, which cannot be described in terms of space and time. It is a spiritual world which is not subject to the deterioration and dissipation characteristic of the physical world.

It is the world in which our minds are "rooted". ... In the opinion of the scientists, God has lately been reinstated as indispensable element in the world ... and that energy and matter have come into existence by the action of a Universal Mind of infinite power. ... People of various cultures have given different names to such a power. We call it God." 21 Celebrated physicist Sarfatti suspects that "...general relativity and quantum theory are simply two complementary aspects of a deeper theory that will involve a kind of cosmic consciousness as the key concept." 22 James Jeans in his classic The Background of New Science concludes that "Our last impression of nature [as offered by the Classical Physics] was an ocean of mechanism surrounding us on all sides. As we gradually discard old physics we see mechanical concepts continually giving place to mental. If from the nature of things we can never discard them entirely, we may yet conjecture that the effect of doing so would be total disappearance of matter and mechanism, mind reigning supreme and alone." 23 Talbot thinks that "the fields which govern consciousness (mind) and those which govern matter" are "part of a continuum, a spectrum of fields within fields." 24 Eddington adds that "The idea of a Universal Mind or Logos would be, I think, a
fairly plausible inference from the present state of scientific theory; at least it is in harmony with it."\textsuperscript{22} Almost all the thinkers belonging to what I would like to call as anti-mind group quote often one of the greatest scientists of our era, Stephen Hawking.

Hawking is not a believer in Mind or God or anything extra-physical and Rene Weber feels "let down by the philosophical limits which Hawking -- by contrast to Einstein, Heisenberg, Schrodinger or Bohm -- deliberately imposes on his work.\textsuperscript{22} But Hawking breaks out of the shell and says "I think that time and space and everything else are really in us."\textsuperscript{27} To sum up, the philosopher Bertrand Russell, who more than anyone else in this era of science and technology believed in the non-existence of extra-physical, expresses a dejected voice. "As regards metaphysics ... I experience the delight of believing that the sensible world is real. But by bit, chiefly under the influence of physics, this delight has faded. ... I find myself in the vast mist of solitude both emotional and metaphysical, from which I can find no issue.\textsuperscript{28}"

I have quoted extensively covering almost all the great scientists of this century, who were, in one way or the other, responsible for the demise of Classical physics, to show that almost all of them posit [strangely enough] something beyond matter. Now we shall proceed to trace the reason or circumstances that made them to believe in the extra-physical reality.
To do that we have to go to the pre-quantum era and as early as the early part of nineteenth century. That was the time, when scientists were struggling to find the nature of light. And at this point of time, Physicist Thomas Young made his celebrated double slit experiment. This experiment is crucial and upon this, as we shall see soon, quantum theory [and of course part of pre-quantum physics too] developed.

Let us suppose there is a beam of light and we shall call the light quanta as photons. Let us place a screen at a particular distance and when the photon arrives at the screen we see light only as the particles with light arriving there in discrete localized units of energy and this energy being dependent on light's frequency. So far there is no problem since energy can never be received as half and this is because light reception is an all or nothing phenomenon. However this particle picture of the light seems to disappear and wave like feature seems to emerge when the light is made to pass through slits. When one of the slits is open light spreads out by a property called diffraction, an essential feature of wave propagation. Still there is a possibility to hold on to the particle picture by ascribing deflection due to the edges of slit. However the key problem with such a particle picture arises when the second slit is also open. By opening the second slit also, by commonsense inference, one would have thought the intensity or overall illumination of the light on the screen to be double. But this did not happen. While at some places the overall illumination was more than four times, at other places the intensity is almost zero. How the points of zero intensity occur especially when both the slits are open? As the light passes through
the slits its behaviour (?) is wave like and not like a particle. Moreover the photon seems to somehow know that another slit is also open when we open the second one and cancel or prevent a photon entering through the second one. How is it possible? The problem is not that the light sometimes behaves as particles and sometimes as waves. It is more than that. Each photon seems to behave on its own. Each photon seems to somehow possess the information.

In the earlier part of this century Louise de Broglie and Erwin Schrodinger proved that electrons behave like waves of matter. But Max Born went further and asserted that these electron waves have no similarity to any kind of material waves. If they are not material waves and cannot be compared to any sort of material waves, then, what are they? Born called them as waves of probability. What are these probability waves? Difficult to explain because "Probabilities in quantum theory have no classic analogue, because they are not simply linearly additive; they are non-linear." 30 Richard Feynman tried to explain through his experiments what these non-linear probability waves are. It is similar to two-slit experiment in that there are two holes through which electrons are fired. Feynman himself was taken aback at the behaviour of electrons. When only one of the alternative routes is open they pass through the hole. But, for example when the second hole is opened after emitting the electrons through the first for a considerable period of time, electrons deviated and did not enter by the first hole. This is amazing. How could they know that they should not enter through the first when the second hole is open? Why do electrons or photons
for that matter, behave in this way when both the holes are open? They seem to decide for themselves when to enter or when not to enter and by what route.

Astonishing. Let us imagine a human being walking on the rails. When the train comes, he pauses, decides and moves out of the way of the train. He behaves so, because he possesses consciousness and intelligence. He had the capacity or ability to judge and act. But the material entity like train moves along the rails even if any obstacle is placed on its path. This is so, because it does not seem to contain any amount of consciousness. But with this in mind consider the behaviour of electrons. Can we say that, these electrons are conscious? If the electrons or other particles, which allegedly make up all the macroscopic bodies, are, in themselves not particles but only waves or patterns that cannot be compared in any way to anything material, then can we suggest that even all the physical bodies including our own bodies are nothing but waves and patterns? If this is true, then shall we be justified to call them as "conscious patterns"? "This is rather weird" and "no ordinary idea of objectivity can accommodate it" writes Pagels.31

The towering figure of Quantum theory and the man responsible for the confusion existing today - Werner Heisenberg explains "It meant a tendency for something. It was a quantitative version of the old concept of 'Potentia' in Aristotelian philosophy. It introduced something standing in the middle between the idea of an event and the actual event, ... just in the middle between possibility and reality."32 Summing up the problems that arose of the experiments such as the
ones described above. Henry Stapp, one of the leading American physicists, wrote: "The Central mystery of Quantum theory" is "how does information get round too quick? How does the particle (or photon) know that there are two sites." So, in essence, we find that physicists are rather dealing with patterns rather than the physical things. "Physicists found themselves dealing with," writes Zukav "energy that somehow processed information (which made it organic) and unaccountably presented itself in patterns (waves)."34

If at all physicists find themselves today talking about and doing research on something extra-physical, they have none to blame. It is their own analysis that has carried them to their present position. They analysed matter and discovered molecules. They proceeded to atoms and then to electrons moving around the nucleus. Having discovered that electron is certainly unknowable [in a wider sense] they turned their attention on nucleus. Nucleus was broken and they moved with protons, mesons, leptons, hadrons and millions of tiny particles that live only for two or three particle seconds. In their search to find the rock bottom of matter, they were led to imagine hadrons containing six quarks and to deal with these imagined [physicists would like to say hypothetical] quarks. Dealing with these imagined quarks they themselves developed a new line of research called quantum chromo-dynamics. This line now lies in the background because of the few profound and unanswerable questions that were posed by the very fundamentals of quark theory. We may also say that it is the very evolution of physics that might have brought a full stop to these quark theories.
Before quantum era, particles and fields were considered as different entities. Then with the dawn of quantum mechanics, the picture changed and with the evolution of quantum, "material particles emerged as only 'packets' of energy, as the quanta of various fields. Thus the inhabitants of the universe were conceived to be a set of fields -- an electron field, a proton field, a electro magnetic field -- and particles were reduced to mere epiphenomena."\(^{35}\)

One of the most celebrated physicists of our own times, John Wheeler, took the picture of physical reality which was already slipping [even though slowly] out of the hands of the physicists to almost beyond their reach. According to Wheeler, matter is something like a quantum foam. According to him, matter floats like a foam as the quanta of energy on the surface of an underlying ocean of cosmic energy. "Wheeler’s proposed picture of space", writes Talbot, "is composed of microscopic bubbles foaming, can be conceptualized as a carpet of foam."\(^{16}\)

Thus we see the very effort of the physicists have landed them outside their domain and they all look like, at the moment, the alien creatures, tumbling and struggling to find their ways in the new land. As one physicist summed up: "Our conception of substance is only vivid so long as we do not face it. It begins to fade when we analyze it. ...the solid substance of things is another illusion. ...We have chased the solid substance from the continuous liquid to the atom, from the atom to the electron, and there we have lost it."\(^{37}\)
When the quantum mechanics made tremendous leaps, many scientists simply refused to believe quantum theory and instead clung to the classical physics. To their dismay soon they found out that they have to change their views. However before proceeding further two small stories will be of great help.

The first one is connected with the Taoist philosopher Chuang Tzu. He once dreamt he was a butterfly flirting and fluttering around, happy with himself and doing whatever he wanted to do. He did not know he was Chuang Tzu. Suddenly he woke up and there he was, solid and unmistakable Chuang Tzu. But he could not find out for sometime whether he was Chuang Tzu who had dreamt he was a butterfly or a butterfly dreaming it was a Chuang Tzu. Between Chuang Tzu and a butterfly there must be some distinction.²⁸

The second story is the one which Bhagavan Sri Ramakrishna used to tell. According to the story, a farmer went to sleep and in the sleep he had a dream. In the dream he became a king and gave birth to seven sons and in the same dream all his seven sons died one after another. Grieving for the death of his seven sons in the dream, he, out of pain in the heart, woke up suddenly only to find his only son in the real life was just dead. Perplexed he sat motionless. When his grieving wife remonstrated him, the farmer replied that he could not decide whom to mourn for, the seven sons in the dream or the only son of real life.²⁹
The way of Quantum world is mysterious. Stories, mythologies and dreams may be more fruitful than the realistic tools to understand quantum theory better.

If there doesn’t exist a world in the sense of solid substances, then how come we perceive and live in such a world? To answer as illusion is too pessimistic. Swami Jitarmananda feels that the answer might come from the Schrodinger’s wave equation and the consequences to this wave equation. What is this wave equation all about? Schrodinger worked on the wave nature of electron and propounded his celebrated equation, that brought the correlation between electron as wave and electron as particle. But surprisingly, “in certain circumstances Schrodinger’s wave function predicted the behaviour of a given particle up to a point and then described two equally probable outcomes for the same particle. On paper as well as in observation no reason could be found for the particle’s varying behaviour. The equation seemed to have entered a Schizophrenic state in which it could not decide which outcome to choose.”40 Shades of Ramakrishna’s farmer and Chuang Tzu?!

This equation of Schrodinger has been proved correct in all the experiments. Such experiments, strangely enough, have taken us to what may be called as multi-dimensional reality. The most strange phenomenon in physics, connected with Schrodinger’s wave equation is polarized light. Now let us see for ourselves how strange and perplexing this polarized light could be.
Polarizers are special kind of light filters. The unique feature of polarizers is that if the polarizer is kept vertically or horizontally inclined in front of a light source, then, only vertical or horizontal light waves can pass through it depending on the direction of this inclination. In this experiment, we keep a polarizer diagonally inclined [or in any angle one may choose] in between horizontal and vertical polarizers. Strictly according to rules, a light, whether it is vertical or horizontal, should get arrested at the second stage. Strangely, light passes through all these stages. How is it possible? How could the vertically or horizontally polarized light change itself into a diagonally polarized light and then immediately to a vertically or horizontally polarized light? Schrödinger’s wave equation states that there is a possibility for a wave to branch itself into different realities at the same time. Now the problem arises. If it was possible for Ramakrishna’s farmer or Chuang Tzu to be aware of two distinct realities, that of dream and waking states, it is because they were conscious persons. Can we say that these waves are also conscious? Moreover, this experiment poses us another problem.

"If the wave function represents possibilities associated with two different particles, then that wave function exists in six dimensions, three each for particle. If the wave function represents the possibility associated with twelve particles, then that wave function exists in thirty-six dimensions."

99
To make himself more clear, Schrödinger himself suggested an experiment which came to be popularly known as Schrödinger’s Cat. Schrödinger suggested that we imagine a cat being put into a sealed box which contains a radio-active source and radio-active particle detector with detector being attached to a bulb containing poisonous gas. If the radioactive particles are emitted, and if they are detected then the bulb will burst and gas will leak out and the cat will die. If none of these happen, then the cat will be alive. Three types of views have been forwarded on the probability for the cat being alive or dead. The first solution is very simple and emerges from classical physics. Accordingly the cat is either dead or alive. We have to open the box and see. The second solution is what is now popularly known as Copenhagen interpretation. According to this interpretation reality emerges only when we observe it. Thus only when one opens the box and looks into it one of these probabilities actualises and other possibility collapses.

For many it was a plausible explanation, and even in our stories neither Chuang Tzu nor the farmer were aware of their surroundings and happenings in the world when they were in deep sleep. We shall soon see Einstein’s and De Broglie’s reactions. The third solution proposed by Everett Wheeler and Graham and popularly known as Everett-Wheeler experiment asserted that none of the branches of Schrödinger’s equation collapses. This interpretation is at odds with the quantum theory since quantum mechanics admits only one of the possibilities to actualize, whereas according to this interpretation, all the possibilities actualise, but in different worlds that co-exist with one another. Talbot says that this theory “denies the existence of a physical reality.” 42
I would like to suggest that this interpretation takes the physics and physicists to all the other possible worlds, while at the same time admitting of the existence and reality of the physical world in which we exist. It may be remembered that we started towards some point beyond the physical world. Here, we are taken around to explore and amuse ourselves at the Grand Sight of all the other possible worlds, which are in essence, non-physical. We shall come to this point later. Because it admits the reality of various worlds, it has been correctly labelled as Many Worlds Interpretation. To sum up "Sri Ramakrishna was known as mad-priest to some persons, as epileptic to others, as sincere sadhaka to some few and as the latest incarnation of God on earth to the fewest. And yet it was the same Sri Ramakrishna. According to the mental elevation or the altered states of consciousness [as modern psychology puts it] of the observer, Sri Ramakrishna, the observed, appeared differently different observers during the same period of observation. And each observer was holding fast to his own view of Sri Ramakrishna ... According to Everette-Wheeler interpretation Ramakrishna's image proliferated into many branches of reality. Each one of these interpretations or each of these branches of reality is true to the particular observer. This is how Schrodinger's wave function decomposes the one reality into many versions of the same reality." If this is true, then, can I say that we make our own world or the external world is in our minds? The temptation is great to say Yes.

Continuing with our central theme, in the year 1927, Werner Heisenberg startled the scientific community with an excellent demonstration of his Uncertainty Principle.
What this Uncertainty Principle is all about? In the subatomic world the particles move at a tremendous speed and their mass increasing with the increase in their s.

Thus anyone who wishes to know the sub-atomic particle should first of all know position and velocity. But Heisenberg's Principle states that both these aspects of a quantum particle can never be known together precisely. If one is fully known, then it follows that the other remains fully unknown. To put it in a different way, the sub-atomic particles can never be known completely. More than the principle, it is the consequences that it brought along with that startled the world of science.

First, even if no one knows what it is, still one can work with a quantum particle. Second, the cause-effect relationship, which holds so good at everyday life does not operate at the fundamental level. And finally at the quantum level the subject-object relationship does not exist at all. But Einstein who always preferred the classical world, and for reasons obvious along with Boris Podolsky and Nathan Rosen published a paper directly attacking the foundations on which the entire quantum mechanics was built up.44 This later came to be known as EPR effect. According to uncertainty principle, the strict cause-effect relationship of the macroscopic world does not exist at the subatomic world. Einstein and his colleagues, questioned, how two sub-atomic particles of the same kind separated by an enormous distance be simultaneously connected, if such a relationship does not exist at all. May be the fact that until the time of Einstein such an instantaneous communication was not discovered, could have made Einstein not to believe in the quantum theory.
In 1964 J.S. Bell working on EPR effect gave a mathematical formulation of the effect, which came to be known as Bell's theorem. One of the implications of the Bell’s theorem is that "at a deep and fundamental level, the separate parts of the universe are connected in an intimate and immediate way." At the time when Bell proposed his theorem, no sophisticated experiments and precision of technology were available and hence no one could either accept or reject the theory. However many were afraid that if Bell’s theorem was demonstrated and proved as experimentally correct and true, then physicists of the future may have to depend on something like para-phenomena. They did not have to wait for long. Less than a decade since Bell proposed the theorem, a group of scientists first, and Clauser and Freedman next, took the theorem beyond the expectations of the physicists of their time. Results of these experiments that startled many scientists and made many of them change their beliefs, however look like a piece of fairy tale, than a result of the scientific experiment. Simply put, such experiment works on a two-particle, zero-spin system. "There are such systems in the physical world where the spin of one particle in the system cancels the spin of the other. In short these two particles act like twin brothers. Let us imagine that the two particles of this system are scattered, simultaneously in two opposite directions on the same plane of polarization. Now if one of the particles is given a change of direction after it has traversed a certain distance (X), then the other particle moving in the opposite direction gets after traversing the same distance (X), exactly the opposite change of direction." Let us term these two particles as A and B. What is surprising is that when A is
given a change of direction, then, almost instantaneously, B also changes its
direction, especially without any action done on it. How is it possible that B knows
the change in the condition of A immediately? May be one would like to say that
they communicate with each other. But, as far as our present knowledge level is
concerned, communication is possible only through the signal and the fastest a signal can
travel is at the speed of light. But, both Clauser & Freedman experiment and the one
done on the similar line by Aspect and his colleague "prove that this
instantaneous communication takes place at a speed faster than the speed of light. But
according to Einstein’s relativity theory, such a super-luminal communication is
impossible. But somehow it takes place. If, this is not possible, then how they are
connected and how the information flows from one particle to another separated by
a long distance? David Bohm, one of the celebrated physicists of our time,
postulated one of the most revolutionary ideas in modern physics — the principle of
non-local Causes. Roughly put [and without going into details] the principle of
local causes states that if something happens to some particle in one part of the
universe, nothing will happen to another similar particle elsewhere in the universe.
However, the Principle of Non-local Causes that Bohm forwards, implies that any
effect on a particular particle at one part of the Universe can be detected in any
other similar particle elsewhere in the universe. "Parts ... are seen to be in immediate
connections in which their dynamic relationships depend in an irreducible way on the
whole system, and indeed on that of broader system in which they are combined,
extended ultimately into the entire universe. Thus, one is led to a new notion of
unbroken wholeness..."51 Bohm’s revolutionary ideas and Aspect and others’ experimental verification have put many scientists in the state of dilemma. Some even refuse to accept the results of these experiments, mainly because it has made them comfortable. They pay "... no attention to Bohm’s work because they hold fast to their conviction that nothing lies beyond the quantum. They reject it out of hand. Because human science is gripped by the Limit Syndrome, and because we have not yet encountered instantaneous communication between objects divided by..., ce and time, the current wisdom holds that instantaneous communication can never occur."52 ESP and other psychic phenomena of such kind elude, till date, physical explanation. But inferring from the above explanation shall we say that telepathy does exist between these two particles and shall we call it as microtelepathy? If, microtelepathy is accepted, then shall we posit that mind exists even in these particles? I am afraid the present science is incapable of answering such questions.

The holistic picture offered by thinkers like Bell and Bohm has led physicists to consider the entire universe as a hologram. Each sub-atomic particle, since connected with the rest of the universe, is conceived of as a holon and each movement of a sub-atomic particle, since it triggers reaction and alters the condition of the universe, is conceived of as a holo-movement.53

In the above description of what I would like to call as physicists’ attempts to know the mind, I have not gone into the technical details and hence have not
covered the entire field, especially quantum physics in its entirety. However, turning to the present theme, the main viewpoints have been presented. Many physicists might object this way of describing or explaining quantum physics. I agree with them, but I also feel that I have succeeded in my attempt to prove that the evolution of physics has led the physicist beyond Physics in search of Mind or Consciousness or Power or Spirit or simply something extra-physical. Very often the philosophical accounts of quantum mechanics come under a sharp criticism, probably because those who forwarded such account lean very heavily on the works of such thinkers like Zukav, Capra and Swami Jiutmananda, to name a few. It is unfortunate that such eminent thinkers should extend the quantum physics beyond a reasonable limit. As it should be clear from the above, I have not gone beyond the limit and yet have shown that Physics has transcended itself, so to say. May be sometime in the future, a physicist will be awarded Nobel for restating the views of Sri Aurobindo that consciousness exists everywhere in the Universe! To sum up in the words of Sri Aurobindo: "...we shall realize that there is a consciousness also in the plant, in the metal, in the atom, in electricity, in everything that belongs to physical nature; ..." 35 and the "...Force that builds the worlds is a conscious Force, the Existence which manifests itself in them is Conscious Being... ." 36 and "All action, all mental, vital, physical activities in the world are the operation of a Universal Energy, a Consciousness—Force ... ." 37


3.2 Seat of Mind – A Neural Question

Coming to biology or neurobiology to be more precise, the effort is to trace or pinpoint mind or consciousness inside the brain. In the West it started with Hippocrates, as we saw, and Descartes identified a particular part inside the neurocranium as a meeting point of mind and body. What is surprising is that over the years many differing views have been expressed with regard to the relation of the state of the brain to the phenomenon of consciousness or mind, and yet there is very little consensus of opinion despite the so-called technological growth and scientific advancement. Despite the grand achievements of neurobiology and medicine, I would like to pose a simple problem. Taking for granted, that there exists a phenomenon called mind or consciousness, whether material or incorporeal, why should it exist only in the brain and not elsewhere in the human body? Answers such as that brain is the controlling organ is not that much convincing [despite that there is lot of truth in that] especially in the light of the development of quantum mechanics and genetics. Even in this era of intelligent individual cells (!) large number of biologists pin their faith in that strange stuff on our top which Aristotle called as a cooling device and its functioning.

Looking at the structure and anatomy of the brain, many early workers of the field, simply felt that consciousness or simply awareness was very much part of the cerebral activity. But the celebrated neurosurgeon Wilder Penfield argued that
awareness is not simply associated with the cerebral activity. Instead, he asserted, that it is only [what he called as] upper brain stem is the seat of consciousness. He went further and stated that only when the upper brain stem is in direct communication with parts of cerebral cortex then consciousness or awareness will arise. By arguing in this way Penfield thought that he could solve the problem of subject and object of consciousness. This early work by Penfield literally woke up the entire field of medicine and neurobiology from the dogmatic slumber.

Following the footsteps of Penfield and Jasper, Moruzzi and Magoun argued that it is reticular formation that should be considered as a seat of consciousness. Since they argued, it is the reticular formation that is more or less responsible for general state of awareness of an individual and also that if the reticular formation is damaged then unconsciousness results, only reticular formation should be taken as a seat of consciousness. Although there is an abundance of evidence in support of this argument, the problem arises with dreaming. While an individual is dreaming some of the normally active portions of reticular formation are not acting, but at the same time, there is an awareness in the individual, at least in the sense of individual being aware of the dream itself.

Another viewpoint is that since it is the hippocampus that is associated with the laying down of the long-term memories and also that consciousness is associated with the registration of long-term memories, it may be concluded that the hippocampus
has more to do with awareness or consciousness than any other portion of the brain. There are many physiologists, especially, John C. Eccles, for the reasons we shall see later, hold a view that Consciousness is associated only with the left hemisphere of the brain.

Talking of the hemisphere of the brain, there is a vast collection of remarkable observations on the patients removed of their corpus callosum. These observations popularly known as split-brain experiments started with Roger Sperry and his associates. These experiments made even the doubting Thomases in the entire field to look for consciousness inside the brain. Since the left hemisphere is capable of speech, if two distinct objects were represented before a subject devoid of corpus callosum, the subject vocalised only the object presented on the right. However, if any matching object to that of the one represented on the right is represented on the left, then immediately the subject pointed out the object presented on the left hand side. These experiments showed that there are two independent actions going on within an individual, one capable of speech and another not. Now I would like to pose a question: What synchronizes these two independent hemispheres in us -- those who are not devoid of their corpus callosums? Can we suggest that it is Mind or Consciousness that which synchronizes? Or can we say that there are two 'conscious' individuals within an individual?
Since, as it was pointed out above, many philosophers firmly believe that language is bound up with consciousness or mind, I would expect majority of them to answer that only the left hemisphere represents a conscious individual, while the right is more or less a servant that carries out the orders of the Master left hemisphere.

However the issue was not so easy as it appeared and the findings of D.H. Wilson, Michael Gazzaniga and others sent shock waves through the community of physiologists and psychologists. It became evident from these experiments that although only one hemisphere was responsible for speech, both hemispheres could comprehend speech. As the experiments speeded up, it also became evident that both the hemispheres can speak out. Then, by the accounts of language combined consciousness, both the hemispheres were conscious. However, contrary to the expectations, the issue was not yet over. Both hemispheres appeared to be separately conscious. For they seemed to have quite different likes and dislikes and both the hemispheres appeared to operate in an entirely detached way from the other. Many philosophical questions regarding these experiments have not been answered. Yet, these experiments proved that though consciousness or mind can be traced within the human brain, there need not be a unique seat of consciousness. But can one be correct in saying that it is the original One Consciousness that has been bifurcated [this line of thinking seems to be a popular one despite the fact that many philosophers like Ramakrishna Puligandla ⁶⁷ and Prof. Barlingay ⁶⁸ are opposed to any such bifurcations of consciousness]?
If at any time in future, that these bifurcated consciousness be amalgamated together then, will it be the same original consciousness? If one argues that it is one and the same consciousness that is appearing at two different hemispheres, then I would like to ask such advocates whether it is possible for One Consciousness to exist at two different places at the same time. It may be argued that, if a photon can be found at two places, why not consciousness? Despite the absurdity of such a line of argument being evident, I would like to grant to those advocates such a possibility. However if One Consciousness can be found at two places simultaneously, then how can one find out which is original and which is duplicate? Moreover, altering the quantum physics in this way to suit one’s purposes is a gross error. Leaving out the technical details, I would like to state that it is impossible to copy a quantum state while leaving the original state intact.** I think this solution can be applied to a wide range of ideas [which I am sure, a Classical philosopher would have simply dismissed as outlandish and fictional] varying from Hofstadter’s teleportation machine*** to Daniel Dennet’s Brain in the vat ⁷¹ and to other such related novel themes.⁷²

However this controversy has been renewed and of late, there exists an opinion among the neurophysiologists that cerebral cortex may be more associated with consciousness. Among numerous experiments that were responsible for this situation, experiments concerning a phenomenon known as blind sight, has triggered a very big controversy and I am afraid at the present level of our knowledge no easy solution seems to be in the sight. Roughly put, the phenomenon is
this: if a particular portion of the visual cortex is removed, it will cause blindness in the corresponding region of visual field. However, some of the experiments conducted by Weiskrantz and others, prove that if an object is placed in the region of the visual field even after the corresponding portion of the visual cortex has been removed, the subject was able to tell with tremendous amount of accuracy what that object is. Interestingly, there also seems to exist a phenomenon complementary to blind sight called blindness denial. In this condition, a patient who is totally blind, surprisingly insists that he is able to see quite well. Penrose says that the subject is seemingly visually conscious of the inferred surroundings. Experiments of this sort seem to prove at least one point, that consciousness must be somehow related to the brain processes! Before proceeding further let us take a look at one of the most astonishing essays to appear in the year 1994 by Wallis. Wallis, summing up the findings of some other scientists, presents an alarming scenario for the philosophers. According to the recent findings of the scientists that not only consciousness or mind is associated with brain but also the moral sense! Researchers Antonio and Hanna Damasio have found out discrete locations in the brain of an intricate system that serves, among other things, as the human moral compass. So, if these portions in the brain are altered, it is quite possible to change the moral nature of a person. Although, the results of such experiments are totally unpleasant, one cannot deny that there is some amount of truth in the results of these experiments. Now let us, at least for a moment, grant that these experiments are valid and also that consciousness or mind does exist within the human brain. But I would like to ask a question despite the obvious philosophical absurdity: What does consciousness or mind do, caught in the trap of
neural connections? The answer comes somewhat indirectly from the results of two most innocuous of the experiments conducted in the recent times. The first performed by Kornhuber and others,76 demonstrated that there exists a huge gap in time [from the macroscopic level it is negligible but from the point of view of brain workings it is highly significant] of about a second and half between the actual willing or decision making and actual taking place of an event, for example, a voluntary movement of an index finger. This means any willed action takes place at a slower rate of pace than a response action.

The second experiment, conducted by Libet and others 77 demonstrated that when a stimulus is applied to the skin of a subject, it actually takes more than half a second for the subject to become aware of the stimulus. This is interesting since brain would have received the input within one hundredth of a second and reflex response would have been achieved within one tenth of a second. But none of the subjects have a feeling that there is any delay at all in becoming aware of the stimulus. They all seem to impose a subjective belief that there did not exist any delay. Other aspects of these experiments also proved that one’s conscious perception can be obstructed by a later event that occurs within half a second. But none of us possess awareness of this delay in our perceptions. Penrose states that "One way of making sense of this curious finding might be to imagine that the ‘time’ of all one’s perceptions is actually delayed by about half a second from the ‘actual time’—as though one’s internal clock is simply ‘wrong’, by half a second or so. The time at
which one perceives an event to take place would then always be half a second after
the actual occurrence of the event. This would present a consistent, but
disturbingly delayed picture of the sense impressions. ... The apparent implication
of these two experiments taken together is that consciousness cannot even be called
into play at all in response to an external event, if that response is to take place within
a couple of seconds or so." 75

While generally agreeing with Penrose's conclusions, I would however like to
see the entire results from a different angle. I suggest that (i) consciousness or mind may
not be present within the structure of the brain itself, (ii) may be our conceptions of time
are wrong and we need an entirely different framework to study the entry of time into our
conscious perceptions and (iii) may be consciousness simply synthesizes the data recorded
in the brain. These and some suggestions made elsewhere may appear a bit outlandish
and sometimes even counter intuitive. Even some of the remarks may be traced to have
the basis of a great amount of philosophical unsoundness. Yet the need to have different
perspective is precipitating for a long time and I hope this way of looking at things will
yield fruitful results.

Whether one agrees with the neurophysiologists' notions or not, it is true
that the experiments such as the ones described above have helped immensely in other
areas, especially, Artificial Intelligence. Such experiments have enabled the
researchers to understand more of the brain functioning and has resulted in the
creation of Neural Networks and Expert Systems. Talking of neural networks and
expert systems, we did mention at the beginning of this chapter that we will also consider the views on mind by the computer scientists and Artificial Intelligence researchers. Since many of the experts in this field look towards brain to solve problems, it is not surprising that the views of these experts have a striking similarity to those from Cognitive Psychology and Neurobiology. Moreover I feel that research in these fields have contributed in more ways than expected in Artificial Intelligence.

Since we will be discussing the major viewpoints in the next chapter let me confine myself to the most important and somewhat different conceptions here. Though many of these experts tend to ignore the concept of mind, for the obvious reasons, of late there seems to be a resurgence of interest in mind and its architecture. Though not all those who do research in cognitive psychology and Artificial Intelligence hold what can be called as a classical empiricist / positivist approach towards mind, we find, surprisingly, in Philip Johnson-Laird such an idea. As Laird puts it "Any scientific theory of mind has to treat it as an automaton." In fact this approach lies latent and implicit in many other advocates’ positions.

We did suggest earlier that consciousness could be a sort of synthesizing element. Francis Crick and Christof Koch seem to come closer to this, but they talk from an entirely different dimension. "We have suggested that one of the functions of consciousness is to present the result of various underlying computations and that this involves an attentional mechanism that temporarily binds the relevant neurons together by synchronizing their spikes in 40Hz oscillations." Since they reduce
consciousness to a sort of representing agent, they land themselves in trouble. And Dennett correctly points out at this error. "So a function of Consciousness is to present the results of underlying computations -- but to whom?" The Queen." Crick and Koch do not go on to ask themselves the Hard Question: And then what happens? ("And then a miracle occurs?") Once their theory has shepherded something into what they consider to be the charmed circle of consciousness, it stops." 81 It should be obvious from the above that the working of consciousness is key to Mind and hence the Artificial Intelligence researchers and cognitive psychologists are trying to trace this mysterious phenomenon.

The workings of the brain have forced the computer scientists and Artificial Intelligence researchers to think more in terms of a sort of parallel functioning. If one pushes further one can find Descartes' ghost standing there. Yes. Modern science has proved beyond doubt that there is no such single point, as Descartes' pineal gland, in the brain. This has forced Artificial Intelligence researchers to abandon the Cartesian Theatre and instead opt for workspace or working memory and "There is no single, definitive 'stream of consciousness', because there is no Central Headquarters, no Cartesian Theatre where 'it all comes together' for the Perusal of a Central Meaner... ." 82 Instead a theory that mind or consciousness consisting of large number of smaller minds is posited.
The most radical treatment of the mind comes from the Father of Artificial Intelligence, Marvin Minsky.\textsuperscript{83} According to Minsky, mind is made up of large number of little processors that he calls as \textit{agents}. Each \textit{agent} makes connections with other and each one keeps a list of \textit{priority}. Big groups of such \textit{agents} are called \textit{agencies} and be group of \textit{agencies} are called \textit{societies}. Minsky characterized these \textit{agencies} as a sort of \textit{little learning machines}. They learn what signals that they should send to others to get the job done. Thus in Minsky’s \textit{Mind} everything is decentralized. And for him there is no need to posit a head or synthesizing agent. Then what about consciousness or for that matter what about awareness? For Minsky, \textit{consciousness} is overrated. "Tell me, how do you know that you are conscious? There are lot of things that you do effortlessly - - like recognizing my face -- that you can’t even being to tell me how you do. You don’t have pipeline to what’s really going on in your mind. I think consciousness is an illusion."\textsuperscript{84} Seymour Papert, Randall Davis, both of MIT, John Anderson of Carnegie Mellon, Sociobiologist Sherry Turkle and many eminent Artificial Intelligence experts seem to be towing Minsky’s line.\textsuperscript{85} Slight variants of and ideas on the similar lines do exist. Baars feels that consciousness is accomplished by "distributed society of specialists that is equipped with a working memory, called a global work space, whose contents can be broadcast to the system as a whole."\textsuperscript{86} Some of the arguments putforward by Michael Gazzaniga in support of his arguments also seem to be pointing out that Mind is constituted by a bundle of semi-independent agencies.
From a different angle Jerry Fodor has argued that majority of the portion of the mind are composed of modules. They are more or less hard-wired to carry on the special activities. However, Fodor states that thoughtful activities of cognition are essentially non-modular and all such activities are carried on by a mysterious and non-modular central facility. Fodor adds further that no branch of cognitive science knows how this non-modular center works. "A lot is known about the transformations of representations which serve to get information into a form appropriate for central processing; practically nothing is known about what happens after the information gets there. The ghost has been chased further back into machine, but it has not been exorcised."

Consciousness as the activity of a serial machine implanted on the parallel hardware of the brain and other such related ideas have thrown more light on how to look at mind or consciousness in a different perspective. There also exists a view that consciousness is a sort of imposition on brain’s functional architecture. Advocates of this viewpoint seem to treat brain as containing a sort of medium in which structures get built as a function of a brain.

The above is only a rough sketch of the important ideas on mind and consciousness. The present stage of research on mind is wide open with more and more new ideas emerging. I wonder whether anyone does actually possess a sufficient knowledge and wisdom to demarcate the right ideas from the wrong ones.
I also wonder whether there exists a system where we can check whether our framework and methods of studying mind are correct. May be our framework is fallacious somewhere. That may be one of the reasons why even the best of minds are not able to solve this vexed problem and why the once promising theories fade out to be mere pale shadows.

We presented the positions of a philosopher that could emerge at sometime in future in the form of a question at the beginning of this chapter. In this connection [and in addition to the justification presented in support of taking up the analysis of mind in the research pertaining to Artificial Intelligence] I would like to suggest that the mind or consciousness has a very vital and significant role to play in deciding what is intelligence?

Although I would very much like to refrain myself from taking sides at the present juncture, yet it may be remarked that despite the enormous amount of evidence [in the form of experimental results] that exists in the side of science, the scientists may never end up in tracing the mind or consciousness. And at the present stage [with lot more discussions to come], I would like to state that from the foregoing, the position of Popper and Eccles stand out from other positions, both in content and expression. No doubt criticisms have been levelled against this theory as well. But I am afraid we know not the amount to which we can rely on such criticisms when the framework in which we study subject itself is in question. This is only
hypothesis. In the future we may have to change opinion, with the emergence of more and more counter arguments and with the development of our knowledge regarding mind and consciousness.

On mind, this far and no further. However the relevance of mind to the evolution of Artificial Intelligence and the role of mind in intelligence will be discussed at the beginning of the next chapter.

3.3 From Mind to Machine

Artificial Intelligence is an expression of the human mind. All sorts of machine making and tool-making are indeed the expressions of human mind. Tools and machines are the extensions of the limbs, the senses and more importantly of the mind. What makes the human beings more unique than other creatures in this world is not merely the possession of mind or intelligence. Rather it is the ability to express the mind or intelligence that they possess and make optimum use of such expressions. All tool-using and tool-making point to the richness of conceptual thought.

Given the richness of knowledge contained in the study of tool-making and the possibility that the study on tool-making might throw more light on the development of man, it is astonishing that very little consideration is given to such a study. I suggest that soon we may find out that the concepts we use are inadequate
to understand man and his origins. This is more so, if we are to continue with the concepts of psychology predominantly based on biology and medicine. It is high time philosophers should come out of the shell to find out how important the considerations of technology are and how the technology and tool-making might help the philosophers to understand how the first mythological, philosophical and scientific ideas were conceived and developed. 91 Technology has changed and is bound to change our ways of thinking. "For example, only recently mechanical clocks have profoundly affected the way that we see time as a steady flow divided into arbitrary intervals, from the ancient notion of time cycling with the stars, and mechanical time dictates our lives and turns industrial society into a vast machine almost independent of the heavens, which is quite a new idea."92

On the uniqueness of a human being and tool-making, I would like to go one step further. It is not merely the use of tools and machines that makes human beings unique. There is ample evidence to prove that chimps do use tools 93 and monkeys learn from the new situations 94 and also to show that our hominid ancestors were intelligent and used expert tools to outwit their fellow apes. 95 [We will return to the question of animal intelligence for a brief discussion in the next chapter]. The making of tools to hunt a prey or for other purposes among the apes have been in existence for long time. What makes the human being distinct and unique is his ability to perceive not only the problems of the present time, but also to have a foresight into the shores of future. He not only casts his glance on the future situations but also is able to perceive
for himself the plausible alternative models of those situations and attempt to find solutions on the basis of such models. History is the silent witness to this remarkable process. This ability to shape his own future, is what makes a human being different from other creatures. On tool-making among the human beings and the apes, Kenneth Oakley says "... to conceive the idea of shaping a stone or stick for use in an imagined future eventuality is beyond the mental capacity of any known apes ..." Precisely that is what -- an ability to create a tool for the future use -- distinguishes man from ape.

If the tools are to be defined as man's creations, his mind's expressions, then what about those creations of man's mind that are not physical? Gregory calls such tools as mind-tools. Mind-tools have been accepted over the period of years, as a sort of expression of the human mind. But I would like to suggest that not all of the so-called mind-tools need be mind's expression or the result of human thinking. For instance, language. It is a controversial question and too unwieldy a subject to be presented cogently and analysed threadbare at this juncture of the work. Moreover we will be discussing some aspects connected with this problem very soon.

If language is intimately connected with thinking or mind, then, human beings should be able to acquire language only with the growth or development of mental faculties. Prof. Jean Piaget's works have suggested that children are poor at logical thinking. Especially children below the age of eight do not seem to have the ability to
perceive logical connections. But by that age they acquire language almost effortlessly. How is it possible, if thinking is invariably connected with language? In this connection Deep Structures and Inherited propensity for language of Noam Chomsky evokes a lot of interest. "It seems plain that language acquisition is based on the child's discovery of what from a formal point of view is a deep and abstract theory -- a generative grammar of his language -- many of the concepts and principles of which are only remotely related to experience by long and intricate chains of unconscious quasi-inferential steps." Edward Sapir has suggested that the language is a "self-contained, creative symbolic organization, which not only refers to experience largely acquired without its help but actually defines experience for us." But in the hands of Benjamin Lee Whorf, this idea took a new turn and it gave birth to a new hypothesis: Language moulds our thinking. If language is what that moulds our thought and mind, then is it feasible to hold that language is a creation of the human mind? It may be possible to hold a view that though language is a product of human mind it does affect [at least at times] the human mind.

The picture is not all that clear. On the one hand thinkers like Kluckhohn and Leighton are impressed by the Whorfian hypothesis. In fact Kluckhohn and Leighton state that the Navaho tongue is radically different from the others and the understanding of Navaho linguistics is a prerequisite to the understanding of Navaho mind! Hoenig had also done a research on the Navaho and posit a theory somewhat on the same lines. But on the other, thinkers
like Lennéberg \textsuperscript{105} and Feuer \textsuperscript{106} have criticised Whorf vehemently for his methodology and his conclusions. However, they are out of our purview and hence let us stop by just mentioning them.

Whether language is an expression of mind or not, the attempts to express the problems human beings have in their mind, as well as those that they face in everyday life in terms of language and try to find solutions to such problems have been in practice for long time. Such a practice gave birth to, I suggest, Syllogistic Logic and Algebra in the early period. Solving problems through equations became a fashion of the day in the middle ages and by the beginning of seventeenth century numerous attempts were made [many of them clandestinely], to create machines that could carry out such calculations efficiently. Such was the fascination for the mechanisation of thought [and language too?], led even such a great philosopher like Leibnitz to comment "If controversies were to arise, there would be no more need of disputaion between two philosophers than between two accountants. For it would suffice to take their pencils in their hands, to sit down to their slates, and to say to each other (with a friend to witness, if they liked) : Let us calculate." \textsuperscript{107}

Modern mathematics and Computers are the results of this process. This process towards the end of the middle centuries took two directions, one towards the development of mathematical logic \textsuperscript{108} and the other towards a physical realization of such ideas. But in the middle ages, even before Leibnitz, Ramon Lull tried his
version of a machine (such machines later came to be known as logic machines), a sort of crude mechanical device, to facilitate the operation of a logical system. It is quite interesting to note that this process in the West, attained its peak only in the middle ages, while abacus which is supposed to be in existence from about 3500 B.C. was a common place in the Eastern Societies. Abacus was used by the Semitic tribes and in India originally and later moved out to China and Japan. Calculating machines and machines of the related kind invented by Blaise Pascal, Gottfried Leibnitz, Joseph Marie Jacquard, Charles Babbage and Hollerith’s tabulator and the earlier efforts in this century by John Von Neuman, brought a new revolution in the mechanisation of thought. However the greedy Golem builders [referred to in chapter I] lied latent till the emergence of an erratic but brilliant mathematician called Alan M. Turing. With Turing developed numerous ideas on thinking machines and after sometime new science (?) by the name Artificial Intelligence emerged. It is Turing’s -- more than anyone else’s -- ideas that gave a big propulsion to the emergence of Artificial Intelligence. Moreover, his ideas had a remarkable amount of philosophical implications as well. So, it is certainly worth considering, even though they do not fall within the domain of philosophy proper. But before moving into Turing and his philosophy, let us have a brief look at the contemporaries of Turing whose ideas were also equally important in shaping Artificial Intelligence into what it is today.

We mentioned earlier that the views of Artificial Intelligence experts have got quite a lot in common with the views of the experts from Cognitive
Psychology and Neurophysiology. So it is not quite surprising that the pioneers of Artificial Intelligence were very much influenced by the findings of Experimental Psychology and Neurophysiology.

Warren McCulloch, the neurophysiologist, in one of his papers in 1943 suggested that it might be useful to think of brain as a computer. But McCulloch was honest enough to admit that his analogy was very far from reality, partly due to our poor understanding of the workings of the neuron. But neurophysiology has taken leaps and has witnessed numerous revolutionary experiments since 1943 and our knowledge of the brain functioning has certainly improved in these four decades. So, with this improved knowledge, today we know for certainty that McCulloch's analogy is incorrect and such an analogy seems to be more and more unlikely in the years to come. However, to his credit, it can be said that only the ideas of the thinkers like McCulloch have propelled researchers to go in for more and more broad-based research and today we live in the world of neural nets and for this Artificial Intelligence community owes a lot to thinkers like Warren McCulloch.

In the middle of the nineteenth century, British mathematician George Boole suggested a system constituted entirely in terms of mathematical notations, for describing Logic -- the laws of thought! Claude Shannon, to whom the modern information science and communication studies owes a lot, used this Boolean Algebra to describe the operation of switching systems and this later on came to be used to describe the information storage in computers. Shannon proposed an
hypothesis that if Boolean Algebra, a tool supposed to represent laws of thought, can be used to describe circuits, then, perhaps such circuits can be used to describe the modes of thought! Imagine a large network of circuits governing our thoughts and emotions! With the philosophers, attribute moral sense to such mega-circuits, or can they accept such a picture of reality where the concepts of free-will and morality will be treated only as fragments of dream or mythology? I have my own doubts.

Shannon did not stop there. He opened up the topic of automatic chess player at the time when chess was conceived as one of the tools for measuring human intelligence. Shannon daringly dabbled in the province supposedly reserved for human thought and came out with incredibly successful ideas. He was the first to point out that it is not a practical and feasible idea to make a computer consider every possible combination of moves, since, even if the computer sorts out one million moves per second it will take for a computer about $10^{96}$ years to select a move. It is unfortunate that Shannon did not continue his search for the possible alternatives and moved over to other fields of his interest. I feel that had Shannon continued his research with intelligent computers and thinking machines, the philosophy of technology would have been enriched by his brilliant notions.17

And finally, a word or two about Norbert Wiener. Although, I feel that the concept which Wiener developed by the name Cybernetics could have existed in the minds of researchers even before the time of his publication, his new approach proved
invaluable in the early Artificial Intelligence research. Wiener proposed a model based on information in contrast to energy model that existed since the time of Newton, as the best way to understand the workings of the Universe. He felt that to model different kinds of scientific phenomena, it would be helpful to explain the events and processes of Nature in terms of transfer of information rather than in terms of transfer of energy. His work is a result of the trouble he felt within and apply Cybernetics describes the functional similarities between humans and...

Before going to Turing, let us also return to the process of mechanisation of thought, that we discussed earlier. It is a sort of naive assumption that exists among the philosophers, that Artificial Intelligence is not in any way concerned with the philosophy proper. But I would like to take a different line of thinking and dare to suggest that the foundations of Artificial Intelligence were derived only from philosophy proper.

We saw earlier that the seeds of Artificial Intelligence can be traced in mythology of the earliest times. These seeds, in the process described above, grew during the time of Empiricism. And Empiricist ideas laid the foundation for further growth of these ideas. Most of the leading Empiricists contrasted sensations from conceptions and many of them including David Hume and John Locke generally upheld that human cognition can be broadly divided into these two -- external stimuli and internal events. They and those empiricists who followed them, in their attempts to solve...
mind-body problem, believed in the existence of finite set of laws to make the
conjunction of sensations and conceptions possible.

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Naturally only these frameworks are reflected in the Artificial Intelligence research programs. Of course much
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In the hands of the two great philosopher-logicians of this century, Bertrand Russell and Alfred North Whitehead, this process took a completely formal shape. Their Principia Mathematica created a mechanical-logical framework for all mathematical reasoning.122 Interestingly one of the very first Artificial Intelligence programs was on Principia and the program demonstrated its abilities by discovering an elegant proof for Theorem 2.85, that was overlooked by Russell and Whitehead.123 Naturally only these frameworks are reflected in the Artificial Intelligence research programs. Of course much water has flown under the bridge ever since Turing, all by himself shook the foundations of the palace which human beings thought to have been reserved for them and he almost created rooms in that palace for the machines that he claimed to think.

How come one ascertain whether a particular being is capable of thinking or whether a particular being is intelligent or not? First, a person may observe that particular being in a variety of complex situations and how intelligently that being
is able to overcome such complex situations. Second, a person may put a variety of questions, arranged in such a way that it requires contemplation for a second or so, and converse with that being to get the answers. If that being’s answers reflect the capacity for thinking, then, that person may come to the conclusion that the being under consideration does possess thinking ability. Or in the case of former, if the being under consideration is able to move himself out of such complex situations in an intelligent manner, then, the subject under consideration can be regarded as intelligent.

Suppose a computer, instead of a human being is under such scrutiny. How are we to decide whether a computer can think? Most possibly in the same way we would have treated a human being. If a computer can dig out of its data bank and memory modules and is able to converse (?) with the interrogator and answers all the questions satisfactorily, and also if such answers are almost indistinguishable from the way any human being would have answered, then, I presume most of us would at least agree that the computer under scrutiny comes very close to thinking. Of course it depends on how one defines thinking and intelligence.

No doubt the picture presented in the foregoing paragraph is a strong operationalist and common-sense viewpoint. This viewpoint is upheld by almost all the Artificial Intelligence researchers across the world. This is not surprising since we have already seen how the empiricist ideas form the foundations of Artificial Intelligence ideologies. We should also remember that when the initial attempts to
provide thinking machines were made early in this century. Behaviourism and Logical Positivism were holding the sway.

This idea was argued very forcefully by Alan Turing in the paper entitled *Computing Machinery and Intelligence* in 1950. He started the article with the question *Can Machines Think?* and suggested a test by passing which a machine can be considered to "think". Such tests came to be known as *Turing Tests* and the machines alleged to pass the *Turing Test* as *Turing Machines*.

To explain this *Turing Test*, let us suppose that a computer is claimed to think. According to this test, a computer and a human being are hidden from the view of an interrogator. The interrogator tries to find which is the computer and which is the human being by putting a series of questions. The answers received and questions posed all take place in an absolutely informal manner. The human being attempts to answer all the questions truthfully and attempts to convince the interrogator that he is indeed a human being. But the computer is programmed to "lie" and gives out the answers indicating that it is indeed a human being. Turing claims now, if in the course of such an interrogation, the interrogator is not able to find out which is the computer and which is human subject, then, the computer is deemed to have passed the test for thinking.

Can this be accepted as a criterion for possessing the ability to think or being intelligent? Despite the strong claims of Turing and his followers, I am afraid such a
test alone cannot be accepted as a measure to decide whether a computer can think. There can be many occasions where it will be too easy for an interrogator to decide which is the computer that is sending answers to the questions. For instance, a human being will be easily stumped if asked to multiply two fifty digit numbers in few seconds of time! Whereas a computer -- despite having been programmed to be -- will do it in no time. Of course this is only when the calculating prodigies are not taking part in the test.127

Again this way of doing things is certainly unacceptable. Even granting the basic premises of the early proponents of Artificial Intelligence, to program a computer to give out contrary answers and then claim that the computer has passed the test is not the best way to prove the things. Making the computer stupid in this way, I am afraid, is not the proper way to prove that a computer can think. Of course, the strong operationists' theory will be incompatible with this sort of conclusion since any staunch operationist is likely to define thinking in a different way. Turing tests will be stronger and efficient, if such tests make room for computers to outwit the interrogator through different means -- though this could be asking too much of a computer.

One of the primary aspects in the activity of thinking is understanding. Only if the question is understood, then the answer can be given. Let us suppose an absolutely non-sensical question is put forward to a human being. The apt response will be that the question will be brushed aside as non-sensical. Do computers possess this capacity to discriminate sense from non-sense? If the interrogator says My father ran across India
twice this morning. It’s a great effort. What do you think?, then, the computer might give out the cautious reply, That sounds ridiculous to me. But if the interrogator presses on, Do you think so? Oh! My pet dog did it once with its tail cut!, the computer will be trapped very soon.

If there is this much of defect in Turing’s concept, then why should one take Turing’s claim seriously and why is there so much of hue and cry about Turing? Despite the obvious absurdities noted, the test has actually a strong claim. Within a given framework, it is certainly one of the better choices. Let us suppose that instead of this test, a computer is assigned a job of stealing the world’s richest diamond, or settling the current reservation problem in Uttar Pradesh without any bloodshed to assess whether it is intelligent or capable of thinking. The computer might very well succeed in such attempts. But they are unrepeatable. Whereas this form of test formulated by Turing is repeatable. Moreover, other alternatives are too difficult to perform and too hard to judge objectively. And finally more than any other reason for why should Turing be given prominence despite drawbacks is the reason that Turing’s Test signalled the completion of the process of shift from mind to machine.

Ironically, towards the end of his article, Turing expresses his apparent belief in E.S.P., especially telepathy. He feels that the ultimate difference between
the human beings and machines will be the ability of humans to have *extra sensory perception*. Probably he felt that intelligence is contained in the nervous mechanism and hence it would be possible to put intelligence in a machine that contains a similar structure to our nervous system. It is interesting to note that one of the earliest psychologists of this century William McDougall believed that telepathy exists between two organisms. This belief forced him to accept a *Theory of Unity of Self* as given by internal telepathic communication between various Monads within the individual. McDougall attributed the case of multiple personality to some sort of loss of internal telepathy between Monads. What is even more surprising is that McDougall went one step further and used the concept that he called as *external telepathy* to explain social cohesion. Margaret Boden suggests that McDougall's view can be transposed into computer terminology, regarding *sub-routines* as Monads. This is interesting. But I am afraid, before taking such paranormal phenomena to other realms, it is necessary, to know exactly what such phenomena are.

Before moving into the next chapter, an observation can be made here. One of the earliest Tamil Saint-poets, Tiruvalluvar mentions that only those who are able to make others understand by clearly expressing their thought can be wise and intelligent. Then can we say that Turing was after all right in his approach or can we conclude that this is the hallmark of intelligence? We shall see how far such claims can stand scrutiny.
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CHAPTER - III


35. Heinz Pagels. (1983), op. cit., p. 239.

36. Michael Talbot. (1980), op. cit., p. 188.


54. In addition to the works cited above, the following three works can be referred to for more on 'quantum mischief'. J.A. Wheeler and W. Zurek. (eds.), *Quantum Theory and Measurement*, (Princeton : Princeton University Press, 1983), esp. pp. 182-213 for


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72. For the popular account of many fascinating experiments of the similar nature refer Iver Sacks, *The Man Who Mistook His Wife For His Hat*, (New York: Summit Books, 1985), and for a well presented and updated arguments and discussions refer Tim Shallice *From Neuropsychology to Mental Structures* (Cambridge, Cambridge University Press, 1988).


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90. For an excellent presentation on 'thing and tool-making', refer Richard L. Gregory (1981), *op. cit.*, Chapters II and III.

91. It is quite surprising that despite Heidegger's' initial attempts to have a philosophical inlook into what technology is way back in 1949 the 'philosophy of technology' has been, by and large, only dimly appreciated in the philosophical circles. For more on Heidegger's views


94. For a fascinating account of how a Japanese monkey learned to wash potato and for more on other learning abilities of monkeys refer H. Lawai. "New Acquired Pre-cultural Behaviour of the National Troop of Japanese Monkeys on Kushima Inlet", Primates, 1968, pp. 1-30.


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119. David Hume. An Inquiry Concerning Human Understanding, (New York : Liberal Arts Press, 1955 (originally in 1748)). In the general references like this I have avoided mentioning page numbers since the concepts referred to will occur at number of places throughout the work.


