NATURE OF THE UNIVERSE

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According to the Quran, "says Iqbal" there are (besides inner experience) two other sources of Knowledge—Nature and History; and it is in the tapping of these sources of knowledge that the spirit of Islam is seen at its best. The Quran sees sign of the ultimate reality in the 'sun', the 'moon', the lengthening out of shadow, the alternation of day and night…. in fact in the whole of nature as revealed to the sense perception[58]."

ان فی خلق السماوات والارض واختلاف اللیل والنهار لآیات لاولی الالباب...

(القرآن آل عمران)

The development of contemporary knowledge in physics, tensor calculus, nuclear science, astronomy, if properly analysed, give definite inklinkings to the unshakable soundness of the words of the Quran.

Advent of the age of interstellar space travel, of new techniques of cosmic photography and radio-sound has ushered in a new revolution, especially in the field of astrophysics which is bound to be more far reaching in its consequences than the revolution which started on the invention of telescope in the seventeenth century. At that time our material world was very limited indeed . The telescope widened our observational horizon several times. It has continued to expand very rapidly with the manufacture of bigger telescopes, and advances in techniques of photography and sensitiveness of the photoplates. Today we can set millions of galaxies like our own, at distances of millions of light years. Each of these galaxies contains millions of stars, like our sun. With the help of radio-telescopes we have discovered large masses or dark clouds and other heavenly bodies which could never be imagined before. Al' these visible and invisible heavenly bodies are sending of visual and radio messages and inviting us continuously to unfold their secrets.

All the astronomical observations were so far taken from the bottom of a restless atmosphere, extending to several hundred miles. This atmosphere is

[58] Reconstruction; p. 128.

divided into well marked layers like troposphere, stratosphere, ionosphere, etc. Each of these layers modifies the electromagnetic radiations passing through it so profoundly that the pictures of heavenly bodies seen by us are completely distorted. But so far there was no way out. Now, for the first time, we have succeeded in getting out of the atmosphere into free space and seeing things as they arc. The Astronomical science, which was sc far purely speculative, has suddenly changed into experimental science.: The human race is ready to jump out into the space and to gain knowledge about sun, moon, planets and the interplanetary space by direct experiments uninterfered with by the atmosphere. *The problems of space, time and gravitation, which were so far matters of mere theoretical interest, are now becoming matters of practical importance, and the knowledge of the structure of the universe is soon going to be of immediate practical use.* These problems are but phases of the cosmological problem, which in its own turn, converges into two main issues: the structure of the universe and the creation of the universe.

There is no doubt that the cosmological problem has been the subject of speculation from earliest stages of human existence. In fact, if we look upon the concepts about the creation of the universe, put forward by various generations and nations, we get a very good idea of not only the scientific facts known to them, but also of their religious beliefs and hidden hopes and motives. They shew the breadth of experimental knowledge attained in every generation, the depth of their thoughts and the height of their aspirations. They also throw light on their social ideals and behaviour. The story of creation of the universe in fact provides a key to the story of evolution of scientific investigation and research, and sums up the total knowledge gained by man at each stage.

"Cosmology" is not an apriori science; its basis lies in astronomy, mathematics, physics, chemistry, astrophysics, etc. The history of these sciences is in fact a description of a rapidly receding and expanding intellectual horizon, not only the observational horizon, but also that of basic concepts on which philosophers raise their systems of cosmological thought

In every branch of knowledge there are certain facts which form the core. These are based on inviolable and experimentally verifiable Laws. On the other hand, there are always certain concepts near the border line of the science which are hazy and ill-defined. In cosmology the reasoning is

generally co-extensive with these ill-defined concepts and uncrystallised ideas, because, in this, we actually try to step even beyond their limits. It is therefore natural that certain parts of cosmology are controversial and not quite certain. But we can neither ignore them nor can we brush them aside simply for this reason, because the advancement of knowledge is always on the border lire, near the horizon.

I

Efforts to comprehend the problem of creation of the universe has been made by different nations from the earliest times in two entirely different ways. By introspective contemplation in the mystic way. The pantheistic dogma that "God is all and all is God" or its reverse theistic belief that the universe is a creation distinct from God, are the results of this effort. The second approach has been inductive and scientific. We wish to discuss the knowledge about creation as it has been obtained by the scientific and inductive methods. The progress of knowledge by this method though slow, is certain and beyond controversy. No doubt, the scientific theories also change from time to time, yet every one of them is correct within the limits of observations on which it is based. Every step forward on this path carries us closer to the ultimate goal, correlation of our experiences for the full understanding of reality as it is.

The cosmologists have put forward a number of hypotheses about the creation of the universe. This group of workers include the well known personalities of Kant, Laplace, Jeans, Jafry, Eddington, Hubble, Gamo, Schind, Lemaitre, Hoye, etc . Every one of the hypotheses they made has some strong points and some weaknesses, but ultimately all of them reduce themselves into two big groups — the Hypothesis of Explosion and that of Steady State. Their propounders also divide into two groups of theists and atheists respectively. This basic difference between the two groups has crystallised in the last few decades.

In this paper I will try to encompass physical cosmology; will try to represent the structure and topology of the universe. I will also discuss its general atomic structure, and after considering the physical and chemical composition of the material world, 1 will try to take a glimpse of that field of events where at a particular moment, for reasons beyond our comprehension, a sudden explosion occurred in yelm, the mother atom, and

after first appearance of light and then darkness, this material universe, as we see and experience today, came into existence. This is a very difficult and complicated problem, but I hope to clarify the issues involved in this most perplexing story hurriedly.

Before the invention of telescope, *i.e.,* upto 1609 A.D. all the astronomical observations were taken by the naked eye. Human eye can see things upto a very limited distance. Upto that time, therefore, our universe was confined to a very limited corner of our galaxy of the milkyway. The population of stars appeared to be spread out equally on all sides. The Sun, Moon and the planets of the solar system occupied an important, rather the most prominent place in the universe seen by the naked eye. It appeared that the earth was at the centre of that universe. Practically all the astronomers believed it to be at the centre, and this inference, based on visual observations, was not far wrong. If you are standing in a forest, with a diameter of 20 or 30 miles, far away from the centre, say at a distance of 4 or 5 miles from the edge, and if a fog envelopes you and you are, not able to see beyond **a** mile or so, you will see trees spread out equally all around you; and on the basis of this observation you will be justified in thinking yourself to be at the centre of the forest. This was exactly the position of astronomers depending on the observations of their naked *eye* They used to consider their planet earth to be at the centre of the universe. This belief was most satisfying psychologically alsc. The most intellegent creature in the universe, Man, should be at the centre.

But, even in that period careful observers had succeeded in coming to the right conclusion. Some 2495 years back in 530 B.C. Pythagous had reached the conclusion that the earth is round. About 300 years after him Erostosthenese had calculated the diameter of the spherical earth, within about 150 miles of the correct value. At about the same time an Alexandrian astronomer, Aristarchus computed that the Sun was several thousand times larger than the Earth, and that the latter was revolving round the Sun. He explained that the stars do not appear tc be changing their position during the course of a year, in spite of this revolution round the Sun, simply because they are so for away from us that the diameter of the orbit of the earth round the Sun is negligible, like zero, as compared to their distances. This correct conclusion, based on observations of thousands of years was put forward by him for the first time in his book on the Sizes and Distances of the Sun and

the Moon. Shortly after, came the towering personalities of Plato and Aristotle who proved that the earth was situated at the centre of the universe and that the moon, the sun, the planets and the stars, all were revolving round the earth with their firmaments in which they were studded. They explained the characteristios of the apparent revolution of each sky by special and complicated laws of revolution of each. Plato and Aristotle were such great intellectual authorities that the voice cf Aristarchus proved to be ac all in wilderness for more or less two thousand years, and the geocentric concept of the universe reigned supreme.

Potelmy put forward evaportive arguments for the earth being stationary at the centre of the universe. One of these was the often repeated argumert that if the earth revolves round the sun, the positi°n of star should change when viewed from different points of the orbit during the course of the year. Because this does not happen, the logical conclusion was that the earth does not revolve round the sun and is stationary at the centre of the universe. The second argument which he put forward with great force was that if the earth were rotating on its axis, or was revolving round the sun, such a strong current of air should be produced that once the birds fly out of their nests it should be impossible for them to return back. Some thirty-five years back when I first read this argument in a book by a medieval Muslim Scholar about the controversies regarding the rotating and revolving planet earth, I was led to believe that this must have been based on some verses in the Holy Quran. It was only later on that I found that this argument had not even a remote reference to the teachings of the Holy Quran. That was only borrowed from Potelmy.

II

These remnants of Greek thought have survived in Muslim scholars because, not realizing that the spirit of the Quran was essentially anticlassical and putting full confidence in Greek thinkers, "their first impulse was to understand the Quran in the light of Greek Philosophy". Along with other Greek theories and speculations, they accepted the Geocentric hypothesis. But the spirit of the Islamic culture could not remain without manifesting itself in the development of science. "The spirit of Islamic Culture is that" says Iqbal 'for purposes of knowledge, it fixes its gaze on the concrete the finite'. "It is clearly visible in the metaphysical thought of the Ash'arite, but appears as a most well-defined phenomenon in the muslim criticism of

Greek Logic"[59] "Abu Bakr Razi was perhaps the first to criticise Aristotle's first figure, and in our own times his objection, conceived in a thoroughly inductive spirit, has been reformulated by John Stuart Mill.

"Ibn-i-Hazam, in his *Scope of Logic* shows that induction is the only form of reliable argument. Thus arose the method of observation and experiment"[60] Although the muslims took the Geocentric Theory, they began the tradition of taking most accurate astronomical observations, and began recording thorn in well preserved almanacs.

Along with many other discoveries during these regular observations, they discovered several variable stars whose brightness varies in regular periods. They called them "Alghol" and this name continues to be used for such stars even today, along with many technical terms which they coined for new concepts and things and which continue to remind us of their intellectual leadership for centuries.

By introducing Astrolob and the Quadrent in astronomical observational practice, the Muslims could take observations correct to r minute fraction of a second. These accurate observations brought out the wobbling of the earth on its axis, the variation of its velocity in different parts of the orbit round the sun, the effect of these changes on the motion of the moon and the irregularities of the motion of the moon itself. The need for changing the earlier computations became evident. The Muslims solved these difficulties on the geocentric hypothesis on the Greek lines. But, at the same time they proved to the world, for the first time, that Plato, Aristotle and Potelmy were not beyond error. This was a revolutionary achievement of their method of scientific research. It proved the supremacy of empirical observations over the established opinions of the great Masters. It began to show the dark corners and the blind alleys of the charmed fortress of Greek philosophy and science. The knots that had been tightened in the string of Astronomy by Aristotle and Potelmy were loosened . This was the first death blow to the authority of Aristotle and Poteltny. It shook its very foundations and thus opened the way for future progress of science on right lines. This was necessary because as Iqbal says

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[59] Reconstruction; p. 131
[60] *Ibid.,* P 128-29

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اول ان بنیاد را ویران کنند

If we wish to erect a new structure we must completely destroy the old foundations built of faulty and distorted bricks. This was done by the Muslims by their uninhibited, correct observations.

If the Muslim scientists had contributed only this much, they ought to have beer given a much higher place in the history of science than *has* been assigned to them by the European scholars. In fact, they have contributed much more in solving the riddle of creation. They introduced tangent, sine and other trigonometric ratios in Astronomical computations and thus simplified them considerably. They discovered the property of logarithm and solutions of six different forms of algebraic equations. By these contributions they unknowingly placed very effective means in the hands of scientist for representing the complicated functional relationship by symbols and signs, and for solving very lengthy and involved astronomical equations.

Even greater and more far-reaching were their contributions in optics. The Greeks believed that just as we feel material objects by touching them, we could see an object only when a ray shot from our eye touched the illuminated object and returned. If this wrong hypothesis had not been disproved b) the Muslims, it would have remained impossible to solve the problems of cosmology in which we dear with heavenly bodies situated at distances of thousands of tight years. Muslims corrected not only this absurd hypothesis of the Greeks, they also formulated and perfected the laws of reflection and refraction of light from plane and spherical mirrors and lenses to an extent that we have not been able to make much advances in this branch of optics, even in the 20th century. It was possible to make telescope and microscope only after this major and far-reaching contribution was made.

III

It was only after these contributions that Copernicus and Tychobrahi could dare to revive the hypothesis of Aristarchus for the sun being the centre of the solar system against the erroneous Geocentric assertions of the

Platonic school. Upto that time the Christian church also believed in the Greek science, but the Ministers Of the church itself began to challenge the Greek hypotheses because these reached Europe through the Muslims end they wanted to prove every thing which the Muslims had accepted, to be wrong. It was *in* this spirit that they started challenging the geocentric hypothesis and struck the correct path by chance! The Europeans who just wanted to change the path in this field, just in the spirit of controversy, found the straight road.

My statement is supported by the fact that although originally the Christian church also believed in the wrong coslomological hypotheses of the Greek, in the fourteenth century we see a strange phenomenon, Some of the clever ministers of the church became its greatest opponents — Oresme, the Bishop of Lisiue, Cardinal Nicola of Cusa, Canon Copernicus of Frunburg, Monk Gardino Bruno. They were all against the cosmology of the Greeks. They tried to prove that earth revolves round the sun and not the other way. They repeated the argument of Aristarchus for the fixed stars not changing their position daring the year, *viz,* the diameter of the orbit of the earth round the sun is so insignificantly small as compared to the distances of stars that it could be regarded as zero. Bruno went even further and said that in the face of infinite bounty of God, the number of stars in the Universe should be infinite. There could be no centre of a body which is infinite and therefore neither the earth nor the sun could be at the centre of the infinite universe. This was really the nearest approach to truth, but according to the Christian church it was such a serious heresy that Bruno was burnt alive.

The change of position of stars during the year which is called parallex, assumed a critical importance in the controversy of geocentric and helliocentric systems. Actually when this problem was examined accurately by telescope it was found that it was not a problem at all. In 1718 A.D. it was first noted that the bright stars Sirius and Archurus occupied positions considerably different from those shown in the charts of Potelmy. This meant that in 1600 years the solar system had considerably changed its position in heavenly bodies. Now when the problem of parallex was minutely examined, it became apparent that the stars of the galaxy do change their positions even during the year, and their change of position is proportional to their distances from the earth. The parallex could thus be used for computing the distances of the stars. This work was actually started about

200 years back when the distances of many of the nearer stars were computed very accurately from the observed parallexes.

It will thus be seen that upto the fifteenth century A.D. it was generally believed that the earth was at the centre of the universe. Copernicus started the study of solar system in 1512 A.D. After a continuous study for 20 years he proved convincingly in his book "De Revotionibus orbium coelestime" that the sun is situated at the centre of the solar system and the earth and all other planets revolve round it in circular orbits.

In 1609 A.D. Galileo constructed the first telescope with which he took observations of the moon, sun, and other heavenly bodies with great accuracy. This triggered a series of far reaching revolutions in the field of astronomy. Keppler proved in the seventeenth century that the planets move round the sun in elliptic orbits. Newton put forward the law of gravitation in the eighteenth century. So far all the astronomical investigations used to be based on detailed examination of old observations and were mainly empirical. A different set of fortuitous laws were supposed to govern the movements of each planet and its firmament. Newton's Law of Gravitation changed the entire situation. Now the sun, moon, planets and all the stars and other heavenly bodies came under cne system.

The irregularities in the movements of Jupiter and Saturn were explained by the presence of an unknown planet in accordance with the law of gravitation. This planet, Uranus, was discovered in 1781 A.D. exactly in the position forecast. Similarly, Neptune and Pluto were discovered in 1846 and 1930 respectively. Now the law of gravitation was accepted as the Law of Nature and it placed the material universe on solid foundations of a mechanical system.

The discovery of telescope and the law of gravitation, and even more than that, the development of technique of photography and sensitivity of the photo plate, opened out ways for further discoveries. We could see about 5,000 stars with the naked eye. Now their number can be counted in hundreds and thousands of millions. Now we know that there are some 150 thousand millions stars in our galaxy which can be well recognised. The bright stars which can be seen in the northern and southern hemisphere of the sky are burning and raging spheres like our sun. In the beginning it was assumed that their masses and brightnesses are also like that of our sun. On

the assumption that their brightness, as seen by us, varies in the inverse ratio as the square of their distance, Newton worked out the distances of all the stars. In the nineteenth century, when the distances of near stars were computed on the basis of parallex, they were found to agree fairly well with the results of Newton, which were therefore accepted to some extent. But when the colours and temperatures of the stars were estimated it was found that the brightness of stars varies very greatly. Some stars ale three hundred thousand times brighter than the sun and some are less bight to the same extent. After this the 'distances calculated by Newton had to be changed completely.

While these efforts were in progress, Herschel put forward the hypothesis that the sun is at the centre of the universe. This was just like the geocentric assumption of astronomers depending on eye observations. However, by the correct analysis of his telescopic observations he suceeeded in reaching the conclusion that the stars in our galaxy are not equally spread in all directions within a sphere. These are spread far out in the equatorial plane and the galaxy is flattened on the poles in the shape of two saucers with their tops placed on each other. So is the case with more than 70 per cent of the galaxies now discovered.

IV

The stars are situated in the universe at far greater distance. Every star is like a lonely ship plying on an unbounded ocean. For instance, in the solar system itself, which is an insignificantly small part of the material world, the distance of the earth from the sun is 93 million miles and that cf Pluto from the sun is 3670 millron miles. This is longest distance in our solar system. Our closest neighbour amongst the stars is L. Centuuri. It is so far off that its light takes about 4.4 years to reach us. In other words it is situated at a distance of abort 6,000,000 million miles, or about 64.5 thousands times the distance between tht earth and the sun.

The stars are often found in groups of two, three or four. The periods of revolution of each of these round the other have been found to be in inverse ratio to their masses. We are thus able to determine their masses from the observations of their motions. It is simpler to determine masses of different members of the solar system, because in this we know the density, volume and velocities of rotation and revolution of different members very

accurately. In this way the masses of different heavenly bodies have been computed with great confidence. We know that the masses of different stars do not vary much. The mass of our sun is about 1992 x 1024 tons, or 1992 million, million, million tons. This is nearly the average weight of the population of stars. The difference between this and the mass of the heaviest and lightest stars is not much. Ordinarily they vary from about one- tenths of solar mass to about ten times that of the solar mass. Of course some stars or their groups have masses varying from about one hundred to one thousand times that of the sun.

The variation in the brightness of stars is, however, much more. Some stars are three hundred thousand times brighter than the sun, and some are three hundred thousand times fainters. So far as the colours of the light sent out by the stars are concerned, we find all the hues of the rainbow and many more on both the sides of the visible spectrum. The colours of the stars help us in determining their temperatures. The variation in respect of volumes and densities of matter in them is far greater.

If we arrange the stars according to their masses about 80 per cent of the stars are arranged in respect of their colours also. The heaviest stars send out light toward the blue and voilet end of the spectrum and are much hotter. The lighter stars are redish and at a lower temperature. The stars with average mass like our sun are yellow. These are called "main sequence stars". Besides these, there are stars of two different kinds — one "White Dwarfs" which have much higher temperatures at their centres than found in the sun. The matter near their centres is so compressed that its density is several hundred thousand times greater than the density of matter in the sun. In respect of their evolutionary stage they are in old age and they occur to the left in the graph for the main sequence stars. They burst at regular intervals. The greater they are removed from the main sequence the longer is the period of their explosion, and ultimately they burst and die out from the visible world.

Another type of stars are found to the right of the main sequence stars. They are usually red, or sometimes yellow. Their temperature is much lower as compared to other stars. They have huge masses, but their matter is spread over such vast volumes that their density is very low indeed. In some of them there are hardly a few molecules in a cubic centimeter. In mass and volume they are several million times larger than the sun. They are called "Red

Giants". Their brightness varies in regular periods. They represent *an* early stage in the story of creation and meet the stars of the main sequence after considerable evolution.

Now we know that our sun is not even at the centre of our galaxy In fact it is a very ordinary member, situated in outskirts in a sprial arm of the galaxy, some 30 thousand light years away from its center. The diameter of our galaxy is about a hundred thousand light years. The sun with its 9 planets, 31 moons, 30 thousand astroids or planetcids and thousands of comets (tail stars), is revolving round the centre of the galaxy with a very great velocity, from west to east, and its one period will be completed in about two hundred million years In words of the Quran it is heading towards a goal !! unkrownto us.

In our galaxy there are many bright or dark nebulae or cosmic clouds. In the galactic system we find some spots of light, some of which are spread over vast areas and are called "magellenic clouds". Some of them are lighted up by bright stars in their midst. Others are dark and hide the stary sky behind them. These produce spectacles like those of holes or vast cracks in the ski. *These used to be considered as cracks and holes in the sky for many years. But the Holy Quran declared in Sura Al-Mulk, Vs* 4 *and 5: He who created the seven heavens in harmony. No cracks or incongruities canst thou see in the creation of the gracious God. Then look again; seest thou any fault Aye, look again, and yet again, thy sight will only return utterly confused and fatigued".*

How true has this Quranic assertion been found. We have examined the heavens again and again but found that there is no such Incongruity as holes and cracks anywhere in the heavens.

The dark clouds are debris of gas and dust left over in the interstellar space after the formation of stars and hide the bright stars at their back and cast shadows which give impression cf holes and cracks in the heavens.

Unlike these, there are patches of light which are called "Steller nebulae". These have a round or flattened shapes and some have even spiral arms spreading out from their flattened mass in the central region. Ore such nebulae with spiral arms can be seen even with the naked eye in the, constellation of Andromeda.

Until about 40 years back all these nebulae were considered to be a part of our galaxy. Kant and Laplace had put forward the hypotheses that these nebulae are formed by the collision of two stars and that our solar system has been produced like this.

In 1925, on the basis of the photographs of the nebulae taken by the big telescopes at Mount Wilson and Mount Polomar, Hubble proved that these nebulae consist of millions of stars. They are not just like the page boys of our galaxy. In fact they are galaxies in their own right. Each of these galaxies has some Alghol stars called "cephaid variables". The periods of the cephaids vary from a few hours to days, weeks, months and years. From the observations of the cephaids in our galaxy whose distances could be calculated by other means Shapley proved that the brightness of all the cephaids having the same period is the same and their brightness does not depend upon the variation of the light emitted by them, but entirely on the inverse ratio of the square of their distances. This provided us with a new yardstiok for measuring the distances of galaxies.

When the distances of galaxies were computed on the basis of periods of the cephaid variables, situated in them, it was found that the *galaxies also group themselves in constellations like the stars.* Fcr instance we now know that there are about 17 galaxies on the group to which our galaxy belong and they occupy an area in space which would take light one hundred and fifty thousand years to traverse. In some cases there are as many as 500 galaxies in constellations. With the help of the biggest telescope we have so far counted about 150 billion galaxies.

If these galaxies are arranged according to their shapes, we find that some of them are spherical or a tittle flattened. These are about 17 per cent of the total number. 80 per cent of the galaxies have flattened out very much like our galaxy and have ultimately thrown out spiral arms as in our case. Some 3 per cent of the galaxies are irregular in shape.

When we arrange the nebulae according to their shapes, they are arranged surprisingly well with respect to their other characteristics also. For instance, the rounder and less flattened a galaxy is, we find it to be in earlrer stage of evolution in other respects and their rate of rotation about their central axis is not very fast. As they become flatter the rotation about the central axis becomes faster. It is believed that the flatter the galaxies are and

the faster they rotate, the older and more advanced they are, but some astronomers differ in this matter and believe just the reverse. However, in all these galaxies, we can easily distinguish different kinds of stars and we find that when the galaxies are very flat they become much brighter and more blue. Another striking thing noticed is that the galaxies of the same shape have similar brightness and similar volumes. In other words their ages and stages of evolution are also similar.

The flattened nebulae with spiral arms spreading out are very important from our point of view, because, they are like our own galaxy. These are populated in the inner central region with red giants and the inter-steller space is very clear. As against this the arms are full of partioles of dust and gases and contain the main sequence stars, Blue Giants and White Dwarfs. *Our sun is a main sequence star.* The presence of dust and gas in these arms, in the region of main sequence stars, plays an important role in the evolution of systems of planets, moons and the comets (tail stars) like those in our solar system.

It has been found that in the solar system the total angular momentum of the planets and moons, etc. is so great as compared to the angular momentum of the sun that its distribution could not be explained on the basis of the hypothesis of Laplace, Jeffry and Jeans. It has now been shown that the distribution of the momentum between the central star and the planets etc. and the other oharacteristics noticed in the solar system could be explained on the hypothesis that when the sun entered the cosmic cloud in the arm of the galaxy and when the plasmio matter expanded and cooled, the planets, moons, astroids and other members of the solar system were formed under the action and reaction of the forces of gravitation and magnetism. This would mean that in 80 per cent of the galaxies, which are like our galaxy, there can exist systems like our solar system, and even in the arms of our own galaxy there could be more systems like those associated with our sun. There must be life like the earthly life or of some different type present on planets at suitable distances from the central star in these systems, but our knowledge is very limited so far. We cannot say anything about this. In fact the stars are so far off that we cannot even observe the small planets associated with them.

From the observations of Cephaid variables in the near galaxies we have been able to compute their distances. These estimates have shown that the

nebulae of similar shape are equal in size and also in their brightness. The Alghols and Cephaid variables cannot be distinguished in distant nebulae, but the discovery of similarity of galaxies has made it possible to compute their distance by the often used proportionality of the observed brightness with the inverse square of theil distance.

VI

The material universe is spread around us upto a distanoe of about one thousand two hundred million light years. This is an expanding universe; every galaxy is receding from us with a velocity which is proportional to its distance.

We can measure their speeds of rotation round their axes and the velocity of their recession from us is oomputed by spectral analysis of the light received from them. This can be done with the help of the principle called "Doppler's principle". The mixed light of different colours, as in sun light, appears to us colourless. Hit is passed through a prism its colours separate out and we see the spectrum. These various colours are really electromagnetic waves with different wave lengths. If the body sending out light and the body on which the spectrometric observations are taken are relatively stationary, the bending of a ray of a particular colour is always the same, depending upon its wave length. If they are approaching each other, with a velocity comparable to the velocity of light, the lines of various colours in the spectrum are shifted towards the violet end of the spectrum. If they are receding from each other, the rays are shifted towards the red end of the spectrum. This is Doppler's principle which applies to all kinds of waves, and even the radio waves sent out from dark heavenly bodies follow it. By the spectrometric examination of all the galaxies we learn the interesting fact that the light coming from all the galaxies is shifted towards the red end of the spectrum, showing thereby that all the galaxies in the universe are receding from us, and from each other.

Hubble had discovered the law of recession of heavenly bodies in 1929. According to this law the velocity of recession of heavenly bodies is 38 times the distance between them in million light years. If a galaxy is 100 million years away from us, it will be receding from us at a rate of 3800 miles per seccnd. If it is 1,000 million light years from us its rate of recession will be 38000 miles per second. This is about one-fifth of velocity of light. The rate

of recession of the galaxies which we have succeeded in identifying with the 200-inch telescope has been as great as 2/3 of the velocity of Iight.

We know from the theory of relatively that no material body can move with a velocity greater than that of light. It is thus evident that with the biggest telescope the most distant galaxy which we will be able to see will be moving with a velocity which will be a little less than the velocity of light. This distance is now not far from our reach. In other words we have reached near the utmost limits of our time and space. Let us try to understand how this universe was created.

VI

In understanding "How" and "Why" in this field of cosmology the greatest difficulty is that we try to extend the results obtained from observations on the tiny earth to the whole universe. But our earth, even our solar system is insignificant like a speck of dust in the universe. *On this earth we cannot produce and experience the velocities of material bodies which we are observing in the universe, nor can we understand the state of the continuum when the dimensions of space and times, so to say, merge into each other on approaching the velocity of light, where time, so to say, becomes stationary, where the meaning of mass changes its very signcance, and where lengths have a different meaning altogether.* But, we cannot solve this problem unless we are clear on this point.

The discussion above leads us to the conclusion that ours is the universe, composed of the galactic systems. They are of the same type of matter as we have in our galaxy. Their atomic and molecular properties are the same as in our solar system. This we have ascertained from spectroscopic analysis.

The question that arises is whether all this matter which composes the material world is something created ? Or that it has been there for ever.

The materialists believe that the matter is from ever. It is the reality. It has always been there and will continue for ever. The second thing which is from ever, accordingly, is its capacity for work — the Energy. The greatest achievement of the 19th century was the supposition of the conservation of energy and matter, which entails that matter can neither be produced nor annihilated, its shape and composition could change, but not its amount. So is the case with energy according to this principle of conservations. Its total

amount in the universe is constant. Its capacity for doing work is shown by the concept of entropy which represents organisation or disorganisations in the universe. The entropy of the universe is increasing or in other words its organisation is becoming more and more perfect. According to this hypothesis a time could come when no work would be possible. The materialists, however, believe that accidents will continue to happen even then and some activity will always continue. To prove this, they take help of the kinetic theory of the gases, and put forward many interesting examples to prove their point. But all these discussions are needed for the difficulties created by themselves by exhypothesi accepting the conservation principle and thereby the eternity of matter and energy.

As the mechanical concept of this universe had reached its height cf advancement at the end of the nineteenth century, it was generally believed that science had reached its perfection, and its further advances would depend upon greater accuracy of measurements and observations. Kelvin had even stated that the future advances of science will be in the sixth or higher r lace of decimal. The atomic theory of Dalton and the Periodic law of Mendelefe had been fully demonstrated. New elements were being discovered with its help. Life was considered to be the result of the mechanical forces operative in matter. *It was asserted that if we could know the exact state at any moment and the condition of all the atoms in the universe, it would not* be difficult to describe its past and future completely by equations.

Soul and God were considered to be the results of blind faith. The scientists could not experiment on God and soul in their laboratories, therefore they were not their concern. *In this very period the Christian Church established after meticulous researches of their scriptures that the material universe was created in seven days in the month of October in* 4004 *B. C.* while the researches in geology unearthed fossils of plants and animals lying buried in layers deep down the earth. The geologists could calculate the time when they were actually buried in the earth on the basis of their stratification.

This came in hundreds of thousands and millions of years. Now those Christian and Jew scientists who believed in God and in the New and Old Testaments found themselves in a great difficulty. According to their own researches this earth has been in existence for millions of years, but the Bible taught them that this earth was created in 4004 B. C. They were simply perplexed. Added to this was the theory of evolution which was shaking

Christianity and Judaism to their very foundations. It was completely at variance 'with the story of creation in their scriptures which taught them of spontaneous creation.

The Christian Church tried to meet the 'geological challenge by saying that though the earth was created in 4004 *B. C. the God in his endless bounty and also to show his miraculous powers had embedded the fossils of millions of years old plants and animals in the deep layers of the earth. Under these circumstances there was no way but for a Christian scientist except either to discard religion altogether,. or to say' that the religion and science are entirely different things* We should not mix them together This is what they did: they either became agnostics and atheists or left their religion behind when they came to their laboratories.

The difficulties which beset the Jewish and Christian scientists do not arise in the case of the Muslim scientists. The Holy Quran does not ask its followers to believe in foolish dogma. It does say that the sun, moon, the earth, the stars and heavens were created in seven days. But the Quran itself makes it clear that the word *'day' used in this context is a cosmic day which is equal to thousands of years of the terrestrial day.* It is therefore clear that 7 days mentioned in the Quran for completion of the creation cf the universe are apparently seven periods or stages. *There is nothing in the Quran against the idea of evolution.* It rather emphasises the power of evolution as one of the most fundamental characteristics of God. There is nothing in the Holy Quran of which we should be ashamed to admit like the Christian and Jewish scientists cf the West. But it appears that we are condemnd to be misled by the westerners. Originally we adopted the wrong geocentric astronomy of the Greeks and put ourseleves in the labyrinth of their design. And now under the misleading teachings of Christian scientists based on their doubts about the Christian dogma, we have started getting ashamed and frustrated about our simple religion.

VII

The most fundamental fact about the universe which has so far been brought out is that all the heavenly bodies are composed of material atoms, which we can identify by radiations emitted by them. Dalton believed that these particles are unbreakable and undestroyable; they are the smallest units of matter. The weight of atoms of different elements is different and on that their chemical and physical properties depend. If atoms of all the elements

are arranged according to ascending order of their weights, they are automatically arranged according to their chemical and physical properties also. And these properties repeat themselves again and again with increase or decrease in their intensity after a certain number of elements. This was the periodic law.

Towards the end of the nineteenth century it appeared that there are over 92 elements consisting of atoms of different weights and colours, etc. The discovery of radioactive elements proved that the doctrine of the indivisible atoms is erroneous. The discharge of electricity in vacuum tubes and researches of Rutherford and Thompson proved that all material particles are composed of negatively and positively charged electrical particles, called electrons and protons respectively. The protons ate at the centre of the atom and the electrons revolve round them in fixed orbits, like the planets round the sun.

In the hydrogen atom, there is one proton at the centre and one electron that revolves round it on a shell or orbit. The Helium atom has two protons in the nucleus and two electrons on the outer shell. But the atomic weight of helium is 4. When this new complication was investigated it was found that in the nucleus of a helium atom there are two neutrons, besides two protons, and the weight of the neutrons is nearly equal to that of the proton. It was also found that the neutrons are very unstable particles. They break up into proton and electron in 13 minutes if they are left free in space. These neutrons have no electric charge and their presence in the nucleus increases the atomic weight only. Thus protons and neutrons make up the nucleus and they together form the "nucleons". As number of protons and neutrons increases in the nucleus, heavier elements are produced

The properties of atom depend upon the number of protons in its nucleus. Their position in periodic table is determined by these. It is called "atomic number". Arrangement of the periodic table shows at a glance both the continuity and difference in the properties of matter.

The number of electrons revolving in the outer shells in an atom is the same as the number of protons in its nucleus. The chemical properties of the atom depend upon these. Their valency depends upon the number of electrons on the outer-most shell. The maximum number of electrons which can exist on a particular shell is fixed. On the first shell round the nucleus

can exist 2 electrons, on the second 8, on the third 18, and so on. When the number of electrons on the outermost shell becomes 2, 8, 18, etc. their capacities for combination with other elements is completely satisfied, their valency becomes zero and they do not readily combine with other elements. This is the case with helium, neon, argon, etc. Originally it was believed that there could be only 92 elements. With the help of atomic reactors we have discovered 102 elements and expect to discover two more thus making a total of 104.

VIII

The atoms in many of the elements are such that the number of protons in the nucleus and the number of electrons in the outer shell remain unchanged, but the number of neutrons increases or decreases depending upon the manner in which the particular atom is formed. The result of this is that although the chemical and physical properties of a particular element remain unchanged, the atomic weights of their different atoms differ. These atoms are called isotopes. So far we have succeeded in separating out 300 isotopes in nature. 50 of these are radioactive. The isotopes are representative of temperatures and radiative balance of the cosmic environment at the time of creation. *Several isotopes are produced by the break up of the radioactive atoms and their relative number present in any body helps in estimating the age of their habitat very accurately.*

For instance, lead was formed as one of the elements at the tim of creation. It is also produced by the radioactive break up of the atoms of thorium, radium, uranium etc. The atomic weight of the lead atoms obtained from all these sources are different, but their chemical properties are the same. These are all the isotopes of lead. The weight of the natural lead atom is 204. The lead atom produced from U 238 weighs 206, that from U 235 weighs 207 and that from Th 232 weighs 208. If in a rock we find all these isotopes of lead and also U 238, U 235 then from their relative amounts present in the rock, we can easily compute the age of the rock. This can be done because every radioactive element has a fixed Half Life Period. The Half Life Period of Th 232 is 14000 million years, that of U 238 is 4500 million years and that of U 235 is only 900 million years. This means that if we have 2 gm of Thorium any where, it will be reduced to 1 gm in 14000 million years and to 0.5 gins in another 14000 million years, and so on. Similarly U 238 will be reduced to half in 4500 millions years and to its half in

another 4500 million years and so en. Thus from the relative amounts of Th 232, U 238, U 235, Pb 208, Pb 206 and Pb 207, which will always be there, we calculate the age of the rock. The ages of rocks of the earth have been computed in this way. The oldest rock that has been found so far is about 2,000 million years old. This shows that the rooks in our earth were solidified about 2,000 million years back.

When we compute amounts of U 238 and U 235 present in the meteors falling on our earth we find the surprising fact that U 235 is nearly always only about 0.7 times of U 238. It cannot be believed that at the time of creation these two isotopes of uranium were created in such different amounts. Therefore assuming that originally their amounts were equal and the present difference in their amounts is due to differences in their half life periods, we find that to reduce the amount of U 235 to its present proportion at least 7 periods of 900 million years must have passed. Thus we know that uranium was created in this universe about 6,000 million years back.

When on our earth we find that the amount of thorium is nearly the same as that of the non radiative elements of similar atomic weights we at once know that even one half life period of this element, *i.e.* 14,000 million years has not yet passed since the creation. Thus when we compute the age of the earth from the relative amounts of different isotope of lead, we find according to Hubble, that the earth was created some 3500 million years back.

We know that all the rivers carry some salts into the oceans and the amount of salts in the oceans therefore goes on increasing from year to year. On computation it has been found that in every 100 years it increases by about a millionth part. We know the present quantity of salts in the oceans. If we compute the age of the earth from the rate of increase of salt, mentioned above we again find that the oceans came into existence on this earth some 3500 millions years back.

George Darwin, the grandson of the famous Charles Darwin, has found that due to the dissipation of energy by the tides, the distance of the moon from the earth increases by about 5 inches every year. At present the distance of the moon from the earth is nearly 239,000 miles. Assuming that the moon originally broke off from the earth and therefore dividing 239,000 miles by 5

inches we get a figure 4,000 million years which would apparently be the age of the moon.

Thus we find that the age of the earth computed from the isotopes of different elements present on it is in harmony with the age of various landmarks in the cosmic history, the formation of oceans, the breaking away of the moon, the consolidation of meteors, etc. It is thus seen that the amounts of isotopes, or rather the amounts of various elements serve as a very important link in understanding the story of evolution of the universe.

It may be shown by these methods that our *material universe came into existence between 5 and* 10 *thousand million years. This is a very important calculation. Because in the history of the human race it is for the first time that we have known by scientific method that matter has not been in existence from ever.* It was created some time between 5 and 10 thousand million years. It may be recalled that all the millions of galactic universes are receding from each other at tremendous velocities and their rate of recession goes on increasing at the rate of 38 times the distances of galaxies measured in millions of light years. The velocities of recession measured near the horizon of the 200-inch telescope are approaching the velocity of light itself. *If we calculate the time when all these galactic systems started their journey outwards from a central position we come to the surprising figures of* 5 *thousand million years.* In other words, we learn that the galaxies which we now find at a distance of 2,000 million light years had started to disperse from a central point about 5 thousand million years.

When we get results of the same order of magnitude about the date of coming into existence of the material universe from all the different methods known to us, our confidence on the results obtained from our terrestrial observations is much increased. Again when we compute the ages of the sun, moon, the stars and the galactic systems, etc. from their brightness, from the variations in radiations emitted by them depending upon their atomic constitutions, their stages of evolution, their velocities — in whatever way we compute their ages, all come to a few thousand mililion years. No doubt, the ages which we obtain by different methods do differ—by some method we get 3 thousand million years, by some 5 thousand million years by some 10 thousand million years or so. But if we keep the difficulties of these computations, and uncertainties involved in view, and then if we also remember that a most insignificant being or an insignificant speck, the earth, is trying to peep out through formidable barriers of space and time, the

difference of a few billion years in these computations is not important at *all. What is important is the fact that all these approaches lead us to a definite beginning of this material universe, a few billion years back.* It has not been in existence from ever.

IX

Now the question arises as to how all this matter was created. It is not, difficult to understand this, if we keep in view the facts that the universe is expanding and that according to the theory of relativity, the expansion or contraction of the universe is as important a property of the four dimensional material universe as gravitation itself.

From our observations we know that all the galaxies are not only receding from each other, but they also rotate round their axes. This rotation affects their shape. *The greater the speed of rotation, the more they are flattened on their poles.* This also shows their stage in evolution. Some 80 per cent of the galaxies are rotating so rapidly that they have flattened out very much and in most cases the matter has burst out in spiral arms, as in the Andromeda Nebulae, or in our own galaxy. Their average kinetic energy of rotation is proportional to their velocity of recession, just as is the case of molecules in gases. This is just according to statisical mechanics. This shows that the conditions which we experience on a small scale in the molecules of gases on the earth are happening on a large scale on galaxies in the inter-galactic space. We find that the galactic matter, spread out in space, is governed by similar laws as the fluids on the earth. Thus we understand how after first creation it must have divided into great pieces now constituting the galaxies after becoming a smoke like mass and how the stars in these galaxies must have formed.

All these observations also show that if today our space, with all its galactic systems, is expanding, at one stage it must have existed highly compressed in a small space. This was the case only a few billion years back. The state in which all that matter, which is spread over billions and billions of miles of space today, must have, about 5 billion years back, been packed up in a small space. At that time its diameter could not have been more than 30 times our sun. The pressure inside this sphere must have been so great that its density must have been several million times the density of water. At that time its temperature must have been millions, rather billions of degrees.

Under these conditions it would be impossible for matter like ours to exist. The whole space must have beer full of the fundamental particles tike protons, neutrons. electrons, in close compaction. Nobody can say how the condition of original compaction were produced. *We can, of course, conjecture that this could have resulted either by the contraction of some earlier universe, or all those fundamental particles had come into being by the command of "Be".* In any case, when the compaction of this mother atom called "Yelm" reached its limit, a start of expansion was inevitable. Just as on July 4, 1754 on the burst of a white dwarf, crab nebulae began to expand, and it can be seen expanding even today exactly like that, the *sphere full of Yelm (the mother atom) burst some 5 or* 6 *billion years back. On this explosion our material universe came into being.*

X

We know that according to the theory of relativity the light Quanta have mass. which can be obtained by multiplying its intensity by the square of its velocity. We also know that when the radiation pressure exceeds a limit it becomes dominant and overcomes gravitation. When the sphere full of "Ye1m" must have exploded the temperature of the expanded mass must have been about 15 million degrees after about a minute. At that moment the mass of light would have been dominant over gravitational mass. *The condition of that moment can be described only by the word "light" because matter had not yet formed.* At that moment the fundamental particles must have started expanding and after the expansion for a few minutes, the conditions must have become favourable for the formation of hydrogen atoms and then for the formation of helium atoms. 99 percent of the fundamental particles must have been used up in building up the hydrogen and helium atoms. After that the other heavy atoms must have formed. Gamo and his colleagues have worked on this problem in great detail and they have established that *all the elements, which we find today in the entire material universe, must have formed within an hour of our terrestrial counting and these must have remained drowned in the ocean of light for ages.*

When this elemental gas must have continued to expand under the pressure of light for something like 300 thousand years, it must have coded to an extent that darkness must have taken place of light, because at that sfagt there were no stars to light up this mass of gases. Naturally at this stage *the dynamics of the system under radiation pressure must have come under the influence of*

gravitation. The condition of that entire mass must have been like smoke, in which there were gases and some small particles of dust.

Now when gravitation became dominant over light, contraction must have star ted. On this contraction the total mass of gas and dust must have divided itself into big lumps which have formed the present galaxies. On this division on contraction, and under the influence of gravitation, it is inevitable that the big lumps of gas must have started rotating round their central axes. James Jeans had worked on these problems some forty or fifty years back and proved that at such a stage all these consequences are inevitable and rotation must start in the great lumps of gas. Commencement of a new turbulence in the whole system, under the above-mentioned rotation, was natural. As a result of this, formation of stars and their constellations and of cosmic nebulae must have started. All this must have taken several million years. After that planetary systems evolved round some of these stars and our planet earth is one of them.

XI

It must have taken about 3 billion years *for life to form* on a few of these planets and thus we came into existence and are trying today to reconstruct this long story on shaky grounds. But we have seen that matter itself is the best guide in reconstructing this story.

We have succeeded in forming estimates of the relative amounts of different material elements present on the earth, in the meteors, in the sun and in other stars. These estimates have been made both on the basis of observations and on the basis of various hypotheses put forward by different cosmologists about the creation of matter and the universe.

Hydrogen constitutes about 55 per cent of the total matter present in the universe; 44 per cent is helium and the remaining 1 per cent is made up of all the other elements. The second point which is brought out by these studies is that after we reach the atomic weight of 100 there is not much variations in the relative amounts of different elements. This distribution of quantities of different elements cannot be fully explained on the basis of the hypothesis of "Steady State" but it becomes evident on the basis of the hypothesis of "Explosion". The light which is reaching us from the stars near the border of our cosmic horizon has taken some 2 billion years to reach us and thus we are seeing the conditions which existed in those galaxies some 2

billion years back, while the light from near stars in our own galaxy takes hardly 80 to 90 light years. Thus the temperatures of the further galaxies must have been much lower. While we are noticing much later evolutionary stages of the near galaxies and stars.

We have thus, succeeded with our biggest telescopes to see the entire evolutionary condition of the universe covering 2 billion years. When we succeed in seeing galaxies moving with the velocity of light, we shall have reached a stage beyond which it would not be possible for us to see. Here the time and space merge into a condition which in Urdu we call by the name of "فلک افلاک" "the heaven over the skies". This is the stage beyond which we cannot-see and our material laws have no meaning. At this stage the cosmic hypothesis of steady state gets perplexed because according to this the universe is infinite and this limit in the infinite has no meaning. It puts forward different concepts of limited space in an unlimited continuum, but all that is really playing with words. It is for such reasons, besides many other reasons, that I do not find the hypothesis of steady state to be satisfactory. To me the explosion hypothesis is more satisfying.

According to this *the formation of the galactic systems started after two distinct stages of light and darkness from condition similar t: smoke.* This hypothesis makes it clear that the action of energy in our present material world started at a particular moment, which was very distant if measured on the scale of terrestrial time, but on cosmic scale it is hardly more than 6 or 7 billion years old. The stars in this four or higher dimensional space-time continuum are advancing in stages of evolution or going down according to the inherent law of their nature. Some of them die out for ever after a few pre-death convulsions. Such sudden convulsions have been observed in stars even in the short history of man on the earth.

It seems that the law of birth, growth, decline and death is not limited to the biological world. It operates in the nature of the physical world also. It suggests that the physical universe is not an ever evolving system; it does not grow ever-lastingly. Finally, it is to die. The ever-expanding universe, as it were, means increase in velocity. This increase may touch the boundary of the light-speed. Celestial objects approaching the speed of light cease to operate according to the micro laws of physics. Their mass must disintegrate into light-waves. So the law of death prevails upon the expanding universe.

This cosmological account that encompasses the physical structure of the Universe, its origin and disappearance leads to certain definite conclusions, which are far-reaching from the point of view of a total philosophy.

One conclusion is that the reality which permeates the physical universe is not static. It is something dynamic. The fundamental particles in the constitution of the physical world, congregation of these particles, known as atoms, their groups, known as molecules, do not represent a static mechanism in the nature of the world. They are produced by the impacts of lighter and heavier vortices electrical, magnetic or neutral in character. Their nature can therefore be best expressed in wave-equations.

Wave equations are the most developed tools to formulate and express in ever active and dynamic system of events. Further more, the wave-equations are methods of apprehension of the dimensions or degrees of freedom of the events of a system. A dimension is an indication of the degree of freedom. A two demensional continuum is more free than a one-dimensional series of events. Definitely a four-dimensional system has a higher degree of freedom for its sequences than that could be obtained in a three-dimensional continuum.

The dimensions or degrees of freedom increase so rapidly with the basic physical events that the latest advancements in physics could master the wave-equation of the hydrogen atom only — the simplest atom in the universe. Consequently, the wave-equation of the atom having the number of 102 is simply a far off cry.

The state of the physical universe from which all these atoms must have emerged should contain so enormous a degree of freedom that it must be beyond imagination. Let us concede, however, that there is no logical bar on wave-equations of this state of the universe, or of any degree of freedom.

The most important conclusion which follows from all cosmological thinking on the basis of the current scientific knowledge is that all lower dimension's have their origin in higher dimensions. Continuum of lesser degrees of freedom are grounded in the continuum of higher degree of

freedom. In other words, from a world of four-dimensional continuum, a world of three, two or one dimensional continuum comes into being.

This principle is of great importance for it gives a definite lead to the nature of ultimate reality. The ultimate reality must have infinite dimensions. It should have the infinite *degrees* of freedom. It is on this basis, that worlds of lower dimensions, of lesser degrees of freedom come into being. To this ultimate reality with infinite dimensions, we give the name of "Allah" (the God). He is the ultimate ground of all finite dimensions or limited degrees of freedom which are there in the different strata of the world.

Thus, our cosmological inquiry, if it does not lead us to the real beyond light waves at least ends in a conjecture about the character o ultimate reality. Any system of philosophy which will be in conflict with this conjecture shall be wrong.

The conjecture is: the existence of a lower independent dimensional continuum is beyond logical comprehension It should demand for its existence a higher dimensional continuum It may lead to the Being of the Infinite dimensions as the Universal stratum behind every thing that exists. To my mind, these conclusions are definity implicit in what Iqbal says: "The finite, as such, is an ideal obstructing the movement of the mind or in order to overpass its bounds the mind must overcome serial time and the pure vacuity of perceptual space. 'And verily towards thy God is the limit', says the Quran. This verse embodies one of the deepest thought in the Quran, for it definitely suggests that the ultimate limit is to be sought not in the direction of stars, but in an infinite cosmic life and spirituality".[61]

[61] Ibid. p 131-132.