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MATHEMATICAL DEMONSTRATION OF HUBBLE'S LAW
Part One (Qualitative)

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Abstract: Have human beings ever found convincing evidence to show that Newton' assumption of unlimited space in the universe is wrong? No! Instead of evidence, they have simply rejected Newton's idea by suppositions which are formulated according to some limited understanding of cosmological observations. In fact, all contemporary theories must leave room for an unlimited expansion of the universe. Furthermore, in order to survive, the theories must posit the existence of a singularity that contains unlimited (or nearly unlimited) matter and energy prior to the creation of the universe This simply means that their theories require something to exist before "creation". Of course in such a proposal, the manner of such a pre-existence is different from what a singularity represents.

Instead of a singularity, (which must avoid the question of what had been wrapped around it) we will allow batches of various sizes of materials of large but finite internal energy such as clouds of hydrogen gas to have distributed everywhere in the universe before the happening of a certain great event. So, in a cosmological model that allows unlimited space in which materials of high internal energy have been uniformly distributed here and there, we will find that Hubble's Law is not merely a brave hypothesis but a reality. However, while agreeing with him that celestial objects are receding with speed that is seemingly in proportion to the distance from us, we must also recognize that the so-called Hubble constant is not really a constant. It varies, but a discernable difference requires a big lapse between epochs of time to be realized at any geometrical point in the universe.

I. General Description

1. Basic Observations

According to the article titled "Crisis In the Cosmos", by Sam Flamsteed, in the March, 1995 issue of Discover, an American magazine, two new astronomical discoveries must be added to the ever-expanding list of cosmological characteristics of the universe:

(A) The age of the universe appears to be younger than quite a few objects at locations closer to us - such as some of the stars in our Milky Way.

(B) An extremely huge collection of materials, spanning at least one billion light years across in space, seems to be moving in one particular direction with extraordinary speed; however, there is no 'great attractor' which can possibly be assumed to provide the motivating power for such a huge mass.

It seems that these two characteristics remain unexplained in contemporary theories concerning the formation of the universe. Therefore, they are viewed as "crises". Before these so-called crises were revealed, scientific workers had a list containing the following characteristics of the universe:

(1) The majority of heavenly objects, moving in groups, are separate from each other.

(2) Heavenly objects are receding from us. The further away they are from us, the higher the speed with which they are receding.

(3) Objects with red shift coexist with objects with blue shift, although the number between them are not comparable. In other words, we do find movements of heavenly bodies, contradicting that of (2).

(4) A large quantity of heavenly objects, such as planets, stars, and collections of such objects, such as multiple star systems and galaxies, are spinning while also making translational movements. Furthermore, in relation to any appointed direction in the universe, the axes of these spinning entities are oriented as randomly as one can imagine.

(5) The distribution of mass in space is roughly homogeneous and isotropic. However, the homogeneous mass is also repetitively interrupted by distributions of layers.

(6) There exists an isotropic background noise, which is supposed to be one form of radiating energy of an electromagnetic nature.

2. A Brief Review of Arguments

Once human beings believed that the stars were roughly uniformly distributed in the universe, which then appeared boundless to them. Sir Isaac Newton defended this idea by arguing that, since the universe was infinite, the gravitational force that a celestial object receives from objects on one side of the universe was balanced by the gravitational force of objects on the other side of the universe. The net zero force thus exerted on each celestial object resulted in an overall gravitational equilibrium among all objects in the heavens. Quite a few people opposed this idea, because it seems that no object could ever deviate from its equilibrium position, otherwise, any minor disturbance would sooner or later destroy the gravitational equilibrium between all celestial objects and would cause them all to fall towards a single point. One of those typical opponents was H. Olbers, who formulated Olbers' paradox. It emphasized that an infinite number of luminous objects (stars) in a limitless universe would result in an infinite brightness in the sky. Since no infinite brightness in the sky is seen, it would be hard to accept a limitless universe.

3. What if …

As we all know, one of the greatest physicists in history, Sir Isaac Newton, lived at a time that the nature of stars was hardly known, and that nuclear energy, particularly the kind of energy that results from a fusion reaction, was unimaginable. If he ever had the knowledge that we have today about the luminous nature of the stars, he might have extended his argument by questioning his opponents thusly:

(1) What if some celestial objects did once fall to a single point because the gravitational equilibrium between them was indeed destroyed? Of course, if such a catastrophe did happen, it must have been a time-consuming process.

(2) What if when falling, all those celestial objects happened to be conglomerations of a particular kind of fuel of high internal energy, such as the nuclear fuel that we know today in the composition of stars?

(3) What if the falling of such conglomerations of high energy fuel occurred before any nuclear reaction had ever been triggered in the universe?

Olbers' Paradox would be of no concern at this stage of questioning, since, as far as we know, nuclear reactions are the only ultimate energy source of luminescence in the universe. Each star must have a finite time duration of illumination. Olbers' paradox can not establish any definite relationship between the duration of illumination of stars and the depth of the universe. In other words, the universe can always have its infinite depth of space before any illuminating object started glowing during the period of this object's glowing, and after such an abject ceases its illumination. So, Olbers' Paradox could have never been there to prevent us from supporting Newton's assumption of a limitless universe.

4. Part of the Time Line

With the removal of Olbers' Paradox, we can imagine what the universe may once have been:

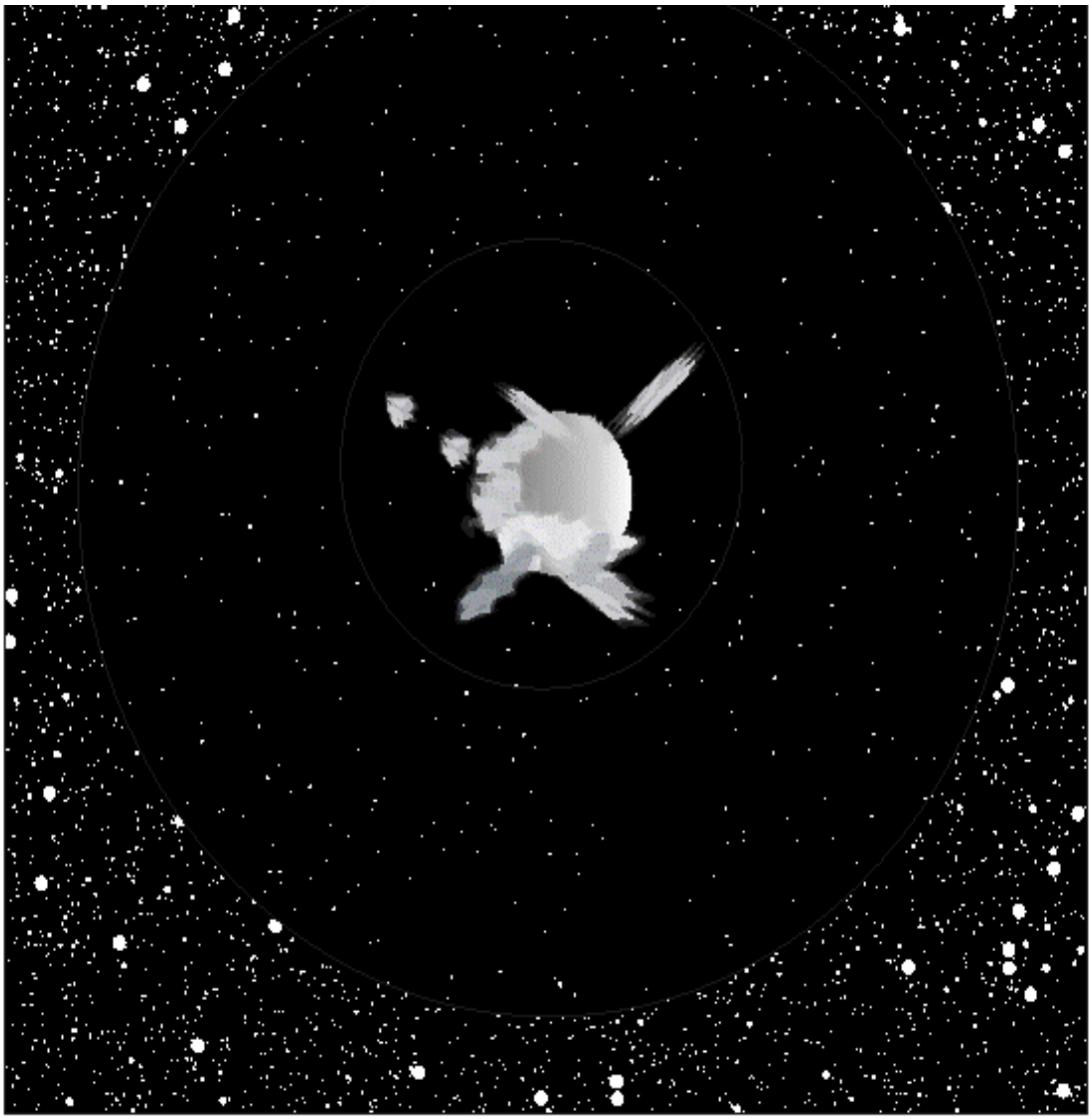
In the beginning, the universe was dark and tranquil There was neither apparent movement nor radiation from any object. Objects with immense untapped energy were quietly "hanging" in space because of the gravitational equilibrium between them. However, in an unlimited space, absolute gravitational balance could not be maintained. Any minor defect in balance would have left an opening for the gravitational force to gradually work in the opposite direction; from balancing those objects between certain distances to pulling them together. The loss of gravitational balance between the heavenly objects would then cause a regrouping of materials. Starting from a minor imbalance, this regrouping of materials would be a time-consuming process. During such a prolonged process of regrouping, those objects that were pulled together by gravitational force would pile up in a single location with two critical components: materials and mechanical energy. There gradually would form many such locations, or single points in space as we will call later,

some gathering more materials than others. Consequently, as these materials continued to fall, a highly explosive entity was gradually formed at each single point. The more materials that fell to the single point, the more available potential energy there was to convert to heat through kinetic energy resulted from the fall. Subsequently, as the objects continued to fall, there was the chance for the temperature of those materials that accreted to increase.

As long as the universe was infinite (if Newton was right), the supply of celestial objects that could fall and collide (if Newton's opponents were right) at a single location would never be exhausted. However, each single location was not an ultimate stable gravitational spot. Because of the ceaseless pull of gravity, materials at each location had the chance to further unite with the neighboring gatherings of materials that had been formed through the same process.

The magnitude of the collisions' impact at each single point would gradually multiply three fold:

(1) As the celestial objects close to a hypothetical single location fell together, a comparatively emptier space adjacent to this single location gradually appeared **(Fig. 1)**. With the progress of time, this emptier space would expand.



An emptier space is gradually developed around a certain location where more materials have been accumulated by gravitation.

Fig. 1

(2) Suppose we had stayed at that single location. With the gradual development of this emptier space, in any direction we look, we would see a dome. The wall of the dome would consist of patches of clouds of those highly explosive materials. As the dome expanded, assuming the roughly uniform distribution of materials in the universe to begin with, the materials would have fallen from the wall of the dome with the quantity proportional to $4(3.1415)R^2$, where R is the distance between us and the wall surface of the dome.

(3) As more and more celestial objects continue to fall, an increasing quantity of mass would accumulate at this single location. A greater and greater mass accumulation at this single location means a stronger and stronger collision each time another patch of materials would fall into it.

However, collisions yield heat. Therefore, the temperature at this single location would accordingly rise at an accelerating pace. The above three points even indicate that the temperature would rise without limit. It it would be only a matter of time before it would reach any designated temperature. Time, however, would be unlimited in the universe.

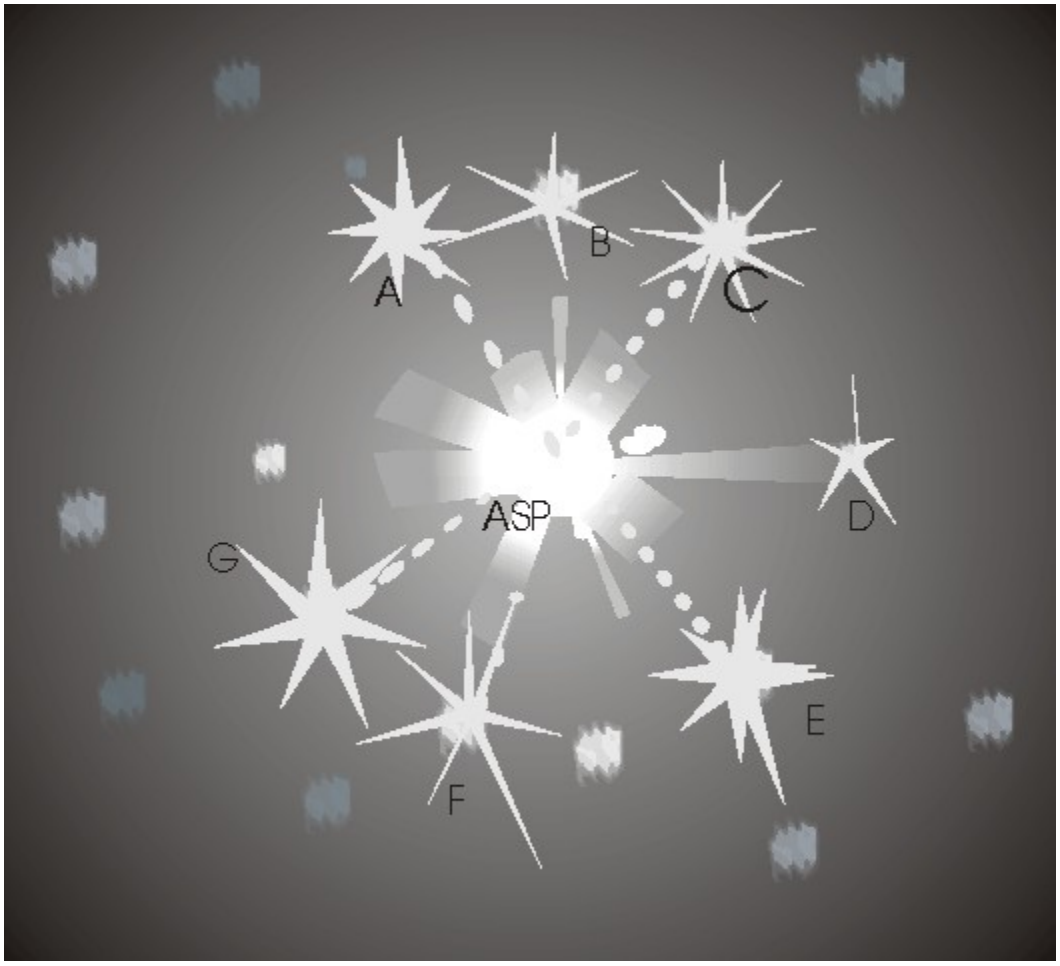
Finally, at one of the many single locations, the material gathering would develop to a conspicuously large size. Its unusually large size, larger than all the others, would cause an abrupt disturbance in the gravitational equilibrium in its neighborhood. Materials in the adjacent space would be pulled together more rapidly and more suddenly than in other areas. The heat accumulated at that location would no longer have enough time to escape. The temperature would reach a certain critical point, and the fuel accreted at this single location would ignite, triggering an intense explosion.

Other than having the collisions trigger the explosions, there exists the possibility of another mechanism capable of inducing such an explosion. Once the mass quantity reached a certain size, the materials that had accumulated at that single location would contract and gravitationally collapse. The immense heat that resulted from such a collapse could also have produced the explosion. Either way, the explosion would be induced by the persistent work of gravity.

Although there is no evidence to show what particular kind of explosion it would be, having the major composition of the falling celestial objects to be hydrogen would have been enough to create an inferno at this single location, and hence, the explosion would indicate a fusion reaction of hydrogen. Of course, this so-called single location would be a point only when compared with the universe; at the time the explosion were triggered, this single point would contain a huge conglomeration of materials.

The hypothesis that those celestial objects were entities made up of a high concentration of fusion material is not ridiculous. After all, it is a well-known fact that modern cosmological observations reveal a great abundance of hydrogen distributed throughout the universe. However, this abundance is only left-over after many billions of years of nuclear reactions.

After the explosion, chunks of furiously hot materials would be ejected from this single point in all directions. Naturally, each chunk expelled would be a furnace of fusion reaction, if our assumption that the accreted material was hydrogen is accurate. If any of these flying torches happened to land on another celestial object of sufficient size that contained the same fuel, a new explosion would immediately be triggered. As previously mentioned, celestial objects may be expected to continue to amass at the single point. Now, let us designate this single point as the **ASP** (**A**ssumed **S**ingle **P**oint) in our model. As the flying torches speed away from the **ASP**, the objects that were already on their way towards the **ASP** might collide with the flying torches at locations other than the **ASP** **(Fig. 2)**. As the flying torches and the late-coming objects meet, a second wave of explosions would ignite and a second generation of flying torches born.



Materials of high temperature ejected from the ASP induced explosions of newly arriving materials at locations A, B, C, D, E, F, and G. These locations are all approximately the same distances from the ASP and thus form a circular envelop embracing the ASP. In a three dimension space, the envelop is then a sphere.

Fig. 2

Because the objects fall to the **ASP** under gravitational influence, which is always isotropic, we should expect that, on the average, the manner in which they fall to the **ASP** is also isotropic. Furthermore, because we have assumed the nature of the fuel to be the same throughout the universe, we should also expect that the torches were ejected with equal force, per unit mass in all directions. These two factors make it reasonable for us to anticipate that the locations of the second wave of explosions to have occurred in a roughly spherical region centered around the ASP.

Now, let's pause here to define a new set of terms that will be used throughout the piece. The line along which a pre-explosion object was moving towards the ASP under the gravitational influence will be referred to as the **radial line**. A velocity towards the ASP will be designated with a **negative** value, otherwise, the velocity will be a **positive** value. Any direction that is perpendicular to the radial direction will be referred to as the **tangential** direction. The objects that have yet experienced an explosion will be referred to as **virgin objects**. The materials contained in the virgin objects are **virgin materials**.

Compared to the flying torches that were ejected directly from the ASP, the torches of the second generation should have the following characteristics:

(1) Their population is greater. This is only natural since the oncoming celestial objects together in general should have

more materials than what had concentrated at the Asp. If the oncoming objects exploded and split, they would together send out many more burning chunks into the space.

(2) They were younger, of course. This is obvious because these torches were products of later explosions.

(3) They would move with a different velocity in relation to the geometric location of the ASP. The reason for this is three-fold:

a) When the first generation of flying torches hit an oncoming object, its momentum is slowed towards the ASP.

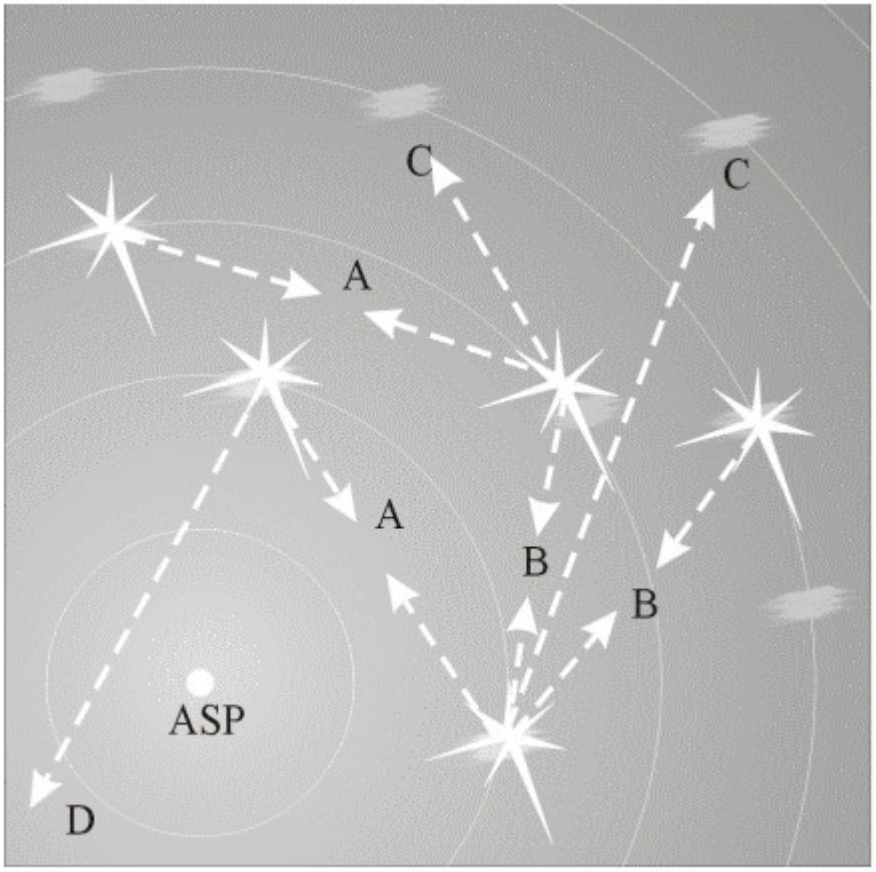
b) The oncoming virgin object explodes before it reaches the ASP due to achieving the maximum possible gravitational speed relative to the ASP.

c) In relation to the ASP, the flying torches of the second generation have a greater path selection, directly away, directly towards the ASP, tangential to a radial line or anything in between.

Obviously, the final path of each of the flying torches of the second generation must be a combination of these three factors. For those torches whose final combined velocity happened to be away from the ASP, there is a possibility of inducing a similar explosion from those objects arriving later.

In a manner similar to that of their own birth, the flying torches of the second generation induce the birth of the third generation of flying torches from the virgin objects from locations that were even further away from the ASP. Statistically speaking, if all the geometric locations of the third wave of explosions were joined together, much like “connect-the-dots”, they would roughly form a sphere with a radius larger than that of the sphere of the second wave of explosions. Both spheres would be concentric.

Since the flying torches of the third generation appeared later than those of the second generation, the nature of the materials converted from the explosions of the third generation should naturally appear younger than that of the second generation. The torches of the third generation naturally belonged to an even larger population than that of the second generation. The virgin objects that offered the material base for the birth of the third generation of torches would be hit by the torches from the second generation, in a direction away from the ASP. The overall speed of the torches of the third generation towards the ASP would be even further reduced. Some of the same wave of virgin objects might have missed the torches of the second generation and hit instead by torches of the first generation because statistics can not guarantee that each virgin object must be met by a torch from the directly preceding wave. **(Fig. 3)**



As the process continues, producing newer and newer generations of flying torches that speed away from the ASP, the birth place of each generation of torches is also gradually farther and farther away from the ASP. As the magnitude of the negative velocities is continually being reduced, there would finally come a certain point where the torches showed positive velocities. Fire would spread as far as the flying torches flew in space, stemming from the ASP. For the same reason that the negative velocities were being reduced, the positive velocities were gradually accumulated.

For the first few waves, the propagation of explosions would occur rather quickly since the virgin objects have moved relatively close to each other. But, virgin objects were originally far apart from each other before they were motivated towards the ASP. After the first few waves, the flying torches must traverse larger and larger distances to hit virgin objects.

Impact with virgin objects would be accompanied by collisions from other flying torches as they traveled in space. Indeed, a tangentially flying torch would have a greater chance of colliding with other flying torches that were either neighbors of the same generation or wanderers from previous generations. In terms of mathematics, if we assume a uniform size for every virgin object and a certain fraction of that size for each of the subsequent flying torches produced by them, it would have been impossible to have the number of flying torches from each generation correspond exactly to the number of flying torches from previous generations. Flying torches that never collided would be left to wander in space. So, when flying torches collide, the gap between them might be one, two, three, or even more generations. However, statistically speaking, the more remote from the ASP a collision happened, the more the collision would be dominated by younger flying torches.

Collisions caused the materials and momentum of celestial objects to combine, but collisions would not be the only manner by which materials and momentum could have consolidated. Flying bodies could also gradually merge if their directions were in proximity. They could also combine through gravitational influence and without contact. Of course, ***rotation*** would be inevitable for gravitational stability. Through collisions, mergers, or gravitational locking-ups, momentum might not be completely nullified. The residual momentum would then cause the new combinations of bodies to continue their journey through space.

Gradually, after a long life of burning, certain bodies would lose their thermal power, but would continued to drift in space. Then, at some indefinite point in the future, the possibility exists to join other space wanderers to establish other

material organizations. Therefore, there could have existed instances where some members of certain material gatherings were still so young that they could still be considered virgin materials while others were so old that the fire within them had long been extinguished. Because of the sheer randomness of their settlements, it is quite possible that a certain “organization” would be dominated solely by flying torches from very old generations while other organizations would be basically dominated by young materials. **Basically this means that a majority of the material organizations, such as galaxies, in the universe could not have been born and evolved locally.** They were composed of members that coalesced from a great variety of backgrounds, different ages and qualifications.

Since a flying torch traveling in a radial direction has a higher chance of hitting virgin bodies that could explode, positive radial momentum of moving bodies would then be transferred and accumulated generation after generation. On the other hand, a tangentially flying torch has a higher chance of encountering other tangentially flying torches that were moving in the opposite directions. In relation to the ASP, the tangential momentum of opposite directions of moving bodies tends to dissipate and nullify each other. Therefore, the more distant from the ASP a heavenly object was established through material combinations, the less obvious is its tangential movement. However, unless the tangential momentum was nullified completely to zero, the residual momentum along the radial line for such a heavenly object could not cause it to move strictly along a radial line. The residual tangential movement would have caused the newly established heavenly organization to appear to be moving somewhat sideways, while its radial motion dominates, showing a tendency leaving the ASP.

;Because of the randomness of the explosions and the irregularity of material distributions, after the numerous collisions and mergers or gravitational locking-ups, the “final organizations” of materials could move or rotate in any manner, at any speed, and in any direction. The general tendency of all of these movements, however, is to have the majority of the organizations flying away from the ASP. An interesting example for this is what is presented to us by the rotating disk of the Milky Way and that of the Magellan Clouds. The rotating axes of these two disks are almost perpendicular to each other, while both disks are moving together along some translation direction. **The phrase “final organization” has only a temporary meaning.** Any organization of materials formed in the aforementioned manner might still have had the chance to encounter other material entities in the future.

As the role of the tangential momentum of the material flow diminished and the role of the radial momentum became increasingly prominent, an observer attached to one of the heavenly objects in this flow would have been able to notice the following phenomena:

(1) He was leaving the ASP with a constant speed. If all the speeds were the result of the explosion of the once homogeneously distributed materials, statistically speaking, all objects that were the same distance away from the ASP should have roughly the same speed. Consequently, a hypothetical sphere that was composed of these objects of the same speed in relation to the ASP would appear to be expanding. Therefore,

Objects on the same sphere generally would appear to be diverging from one another. However, some might be slowly moving towards each other because of the residual tangential momentum that had not been completely nullified.

(3) Objects closer to the ASP would leave that point with a slower constant speed, while objects that were further away from the ASP would travel with a faster constant speed. The speed difference would lead the observer to believe that, with few exceptions, all heavenly flying objects were generally moving away from him, regardless of whether they were on the same sphere as his or not.

Up to now, the cosmological picture that is presented to us in the above descriptions has been based solely on one assumption: bodies of highly explosive materials were once uniformly distributed throughout the infinite universe, and it was the omnipresent gravity that pulled them together and triggered all the reactions. By further assuming to have hydrogen to be the highly explosive material, mathematics would help us to accomplish what we have described. The reactions triggered by gravity would also certainly be continuously releasing huge amounts of radiating energy, which includes all forms of luminosity at all locations, as well as the so-called background noise in the entire space.

5. The Onion Model

We assume that all the aforementioned reactions were initiated at one single location and after that, reactions of the same nature spread wave after wave in roughly the same manner in all directions. For a quantitative support for this assumption, it should only be reasonable for us to further assume a mathematical model in which material distribution in space is consisted of numerous concentric spherical shells of homogeneous substance wrapping around a single point. Physical properties between all shells, or layers, are identical; boundary between any two layers has no physical existence but only mathematical significance. Layer after layer like an onion. With the onion model, a mathematical treatment will enable us to realize the following:

(1) Material flows demonstrate a positive linear proportional relationship between their moving speed and their distance with respect to the ASP. This is the long sought Hubble's Law that is waiting for confirmation.

(2) If some measurement regarding the intensity of electromagnetic radiating energy is made late enough after the initial explosion, the sum of the radiating energy intensity along any radial direction will show the same magnitude compared with those along other directions, even if the location where the measurement is made is not at the ASP. Such a magnitude will show approaching a certain low limit, as well. **This will help to explain the isotropic observations of the background noise.**

Now, we could qualitatively answer Olbers' Paradox: The universe was infinite, the number of objects were also infinite, but not all the objects glowed at the same time. Instead, they radiated sequentially. By the time some ignited, others were extinguished. Therefore, the sky could not have simultaneous luminous objects and could not shine with infinite luminosity. Instead, mathematics in later chapters supporting point (2) above will show that **the luminosity in the whole sky must have a limit.**

If we apply the onion model in examining the so-called "crises" listed in Flamsteed's article, we can easily accept these "crises" as some simply natural outcomes of the evolution of the universe. If these natural outcomes must be viewed as crises when measured by other contemporary theories, such a view can only serve as evidence that these "crises", or the observational facts are at odds.

In the onion model, **the portion of space that contains all the luminous objects that we have been able to detect is not the entire universe,** but a tiny spot of an unlimited universe.

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