GRANGE AND THE UNIVERSE

By Tommy Hourigan

For most people, the place of their birth or where they grew up remains a special place for the duration of life. It is usually remembered with fondness and nostalgia, and there is often a magnetic pull to return for those who moved away in the course of living their lives. For those who live out their lives entirely in the locality where they were born or grew up, it may be challenging to understand the depth of these feelings.

It is amazing that the place or location of birth and youth, though just a tiny spot on a map of the world, can mean so much for the duration of one's life, even if the years that followed growing up were lived out elsewhere.

Grange for me was the centre of the Universe when I grew up there, more than half a century ago. A trip to Bruff, some three miles away, was as far as one could hope to travel – a trip to Limerick City was almost unattainable, while Dublin or such far-away places might as well have been in Antarctica. Some of my age group reached their late teens or older age before visiting the seaside for the first time. Travel overseas may not have occurred until a person was much older again.

The Universe

And yet, despite being confined geographically in those days to a 'dot' on our planet, Earth, which in turn is almost an infinitesimally tiny speck in the Universe, it was possible to see the Sun some 93 million miles away, to marvel at the Moon some quarter of a million miles away and to gaze at the stars in the sky on clear nights, having little appreciation of the vast distances involved. We were too young to question the scale and meaning of it all.

Have you ever thought about the Universe and its vastness, or even our solar system, miniscule in the context of the Universe, and wondered and pondered about how it all came to be and why?

If you are a monotheist, a believer in one God, you may well be satisfied to believe that God created the Universe and for a purpose and though that purpose may not be altogether clear, to conclude that it is best to accept without serious questioning. This is not to say that all monotheists accept religious teachings unquestioningly on matters of the Universe, its beginnings and purpose.

If you are an agnostic or atheist, sceptical about the existence of God, or indeed, an outright disbeliever, your mind may seek logical or scientific answers to the many questions that can arise regarding the creation and continuation of the Universe and the meaning of it all.

Distant galaxy *(NASA —Hubble).*

If you are new to exploring matters of the Universe and you google this topic, it is possible that you will become very quickly confused as you struggle to gain an elementary understanding of the myriad of technical and scientific terms and names encountered. Purported explanations are likely to throw up terms such as *the big bang, black holes, dark matter, singularity, quantum physics, parallel universes* and much, much more. I have taken this journey time and time again, and I must confess that I have gained just a very superficial understanding of the broad science. I realise that I will never understand at the level of Stephen Hawking or the scientists at NASA and other such organisations throughout the world.

However, there are basic facts, scientifically proven and accepted about the Universe, which can be reasonably comprehended by a non-scientist. These facts can grip the imagination and provoke thought or at least wonder and awe. They do for me.

Some of these accepted facts are set out hereunder in the hope that, if you are not already conversant with some of them, you will find them interesting and thought-provoking.

The Milky Way Galaxy

Galaxies are sprawling space systems composed of dust, gas and countless stars. The number of galaxies cannot be counted – the observable Universe alone may contain 100 billion. Some of these distant systems are similar to our Milky Way Galaxy while others are quite different.

We live in one of the arms of a large spiral galaxy called the Milky Way. The Sun and its planets (including Earth) lie in this quiet part of the galaxy, about halfway out from the centre. The Milky Way is shaped like a gigantic whirlpool that rotates once every 200 million years.

Galaxies with less than a billion stars are considered "small galaxies". In our galaxy, the Sun (which is a star) is just one of about 100 billion stars. It (galaxy) is so large that light takes 100,000 years to cross from one side to the other.

Our Solar System

Our solar system, located in the Milky Way Galaxy, primarily comprises the Sun, the Moon and eight planets. The eight planets orbit around the Sun continuously. In the case of Earth, a full orbit takes an Earth year. The other seven planets take varying times to orbit. Our Moon orbits Earth.

From nearest the Sun, the 8 planets and their average distances from the Sun:

Mercury	35,000,000	(35 million)	miles	0.387 AU
Venus	67,000,000	(67 million)	miles	0.722 AU
Earth	93,000,000	(93 million)	miles	1.000 AU
Mars	142,000,000	(142 million)	miles	1.520 AU
Jupiter	484,000,000	(484 million)	miles	5.200 AU
Saturn	889,000,000	(889 million)	miles	9.580 AU
Uranus	1,790,000,000	(1.79 billion)	miles	19.200 AU
Neptune	2,800,000,000	(2.8 billion)	miles	30.100 AU
Pluto	3,670,000,000	(3.67 billion)	miles	39.500 AU

(Pluto is no longer regarded by the scientific community to be a planet, it is now regarded as a dwarf planet).

These distances are staggering and difficult to visualise. The scientific community regards the distances using a term *Astronomical Unit* (see AU above). The unit of measurement is 1 AU, being the distance from Earth to the Sun (93 million miles). The distances of the other planets to the Sun can, therefore, be expressed as 'so many' AUs. Some are less than 1 AU while others such as Neptune (30.1 AUs) are many more.

Immense as these distances are, they pale into insignificance in the context of the magnitude of distances in the wider Universe, as will be seen later.

The Sun and Earth's Moon

THE SUN, the supporter of all life on earth, is 93 million miles from Grange. To put this into context, the driver of a car, travelling 20,000 miles a year, would have to live for 4,650 years to cover this distance. An airliner, cruising continuously at 500 miles an hour, would require in excess of 21 years to cover the distance.

It is absolutely incredible that despite the enormous distance to the Sun, the naked human eye can see it, and such is the strength and power of sunlight, the observing person in Grange should not look directly towards the Sun, lest permanent eye damage would be sustained.

The Sun is enormous, such that in the region of 1.3 million (1,300,000) 'Earths' could be contained within it.

The Sun is composed primarily of the chemical elements hydrogen and helium. The diameter of the Sun is about 865,000 miles. *You could line up 109 Earths or almost 400 Earth Moons across the face of the Sun.*

At some time into the far distant future, the Sun *(a star)* will cease to exist (some scientists say in the order of 5 billion years from now), but the process of the sun's demise will have made Earth uninhabitable long before then. In a few billion years, the sun will become a red giant so large that it will engulf our planet. But Earth will become uninhabitable much sooner than that. After about a billion years the sun will become hot enough to boil our oceans. With our sun dead eventually, the 'bulb' will have gone out, and there will be no source of light and heat to sustain life on Earth.

EARTH'S MOON is much nearer to Grange than the Sun; it is in the order of 388 times closer. There are some factors that vary the Moon's distance from Earth, but for the purpose of this article, a distance of 240,000 miles is used. The return distance is, therefore, 480,000 miles.

A former and deceased postman from Grange covered this (return) distance at work in the course of 56 years, mostly on a bicycle.

A car driver, travelling 20,000 miles a year, would require 24 years to complete the return distance. A motor car moving continuously (24 hours a day) at 70 miles per hour would take almost 286 days to cover the return distance.

Our Moon is a terrestrial body and is rocky like Earth. The Moon has a diameter of just under 2,200 miles; that is a little more than a quarter of Earth's diameter. Because it takes 27.3 days both to rotate on its axis and to orbit Earth, the Moon always shows us the same face. We never see other 'sides' of the Moon from Earth. We can see the Moon because of reflected sunlight.

Some, but not all, of the other planets have their own moons; even some have a number of moons.

The Planets

MERCURY is one of four terrestrial planets in the solar system and is a rocky body like Earth. It is the smallest planet in the solar system – it has a diameter of just over 3,000 miles.

VENUS is a terrestrial planet, the second planet from the Sun and is sometimes called Earth's "sister planet", because of their similar size and gravity. It is also the closest planet to Earth. It has a rocky body like Earth. Venus is by far the hottest planet in the solar system. It has a diameter of just over 7,500 miles, somewhat less than Earth's diameter.

EARTH is the third planet from the Sun, is the densest planet and has the highest surface gravity in the solar system's four terrestrial planets. It is believed that the planet formed about 4.54 billion years ago. Interestingly, the Universe is thought to have been born about 13.7 billion years ago, a very long time indeed before Earth was formed. It is believed that our solar system is the same age as Earth. Earth's equatorial diameter is 7,926 miles, being slightly less from pole to pole.

Earth orbits the Sun once every year. *While sitting in an armchair in Grange or tending to the garden or livestock, or sipping a drink in The Hamlet, one has no awareness that Grange, a location on planet Earth, is travelling through space at a speed of 67,000 miles per hour.* That is in the region of 1,000 times the speed of a car travelling on an Irish road! One orbit of the Sun by Earth is a distance of 584 million miles (in a year). The orbit is an ellipse rather than pure circular in shape. *So, if you are as old as me, you have put up a lot of mileage, which you may not have known about.* Earth is also moving in other ways, involving massive speeds and distances: Earth rotates on its axis once every day, causing our day and night. Our solar system, of which Earth is a component, is moving within our galaxy, the Milky Way. The Milky Way, in turn, is moving independently as a unit. That adds up to a lot of speed and distance that we don't notice.

Earth is made up of four distinct layers as follows, beginning at the centre and working outwards. The *inner core* is in the centre and is the hottest part of Earth, it has a thickness (radius) of approximately 1,200 km (750 miles). It is solid and made up of iron and nickel with temperatures variously estimated between 5,500°C and 7,000°C. The *outer core* is the layer surrounding the inner core; it has a thickness of approximately 2,300 km (1,430 miles). It is a liquid layer also made up of iron and nickel. It is still extremely hot with temperatures similar to the inner core. The *mantle* is the widest section of Earth. It has a thickness of approximately 2,900 km (1,800 miles). The mantle is made up of semi-molten rock called *magma*. In the upper parts of the mantle the rock is hard, but lower down the rock is soft and beginning to melt. Movement in the mantle leads to tectonic activity such as volcanic eruptions and earthquakes on the crust. The *crust* is the outer layer of Earth. It is a thin layer of 0-60 km thick. The crust is the solid rock layer upon which we live.


That litle spot on Earth called 'Grange'.

It is thought that there is enough gold at the core of Earth to cover the surface of the planet to a depth of twelve to thirteen inches or more. Unfortunately, it is 1,800 miles below our feet and at many thousands of degrees centigrade. So, if you have invested in gold, don't become overly concerned about the laws of supply and demand in the world of economics and the impact on gold prices. There is no prospect of tapping into these massive gold deposits anytime soon. But perhaps in a million years or so, tarmacadam will cease to be the road surface of choice. So, leave long term plans after you to have the family gold off-loaded before prices collapse eventually!

As regards life on Earth, while our planet has existed for over 4.5 billion years, scientists believe that earliest *Homo sapiens,* from whom modern mankind evolved,

lived about 200,000 years ago. In contrast, earliest dinosaurs existed about 230 million years ago and became extinct about 65 million years ago. It is thought that the oldest life on Earth existed about 3.5 billion years ago in the form of microbes.

MARS is a terrestrial planet, the fourth planet from the Sun and is the second smallest planet in the solar system. It is a desert planet with dry land that appears red in colour. Mars is approximately half the diameter of Earth, just over 4,200 miles.

JUPITER is the fifth planet from the Sun and the largest planet in the solar system. It is a gas giant as are the other three 'outer' planets, Saturn, Uranus and Neptune. The equatorial diameter is almost 89,000 miles.

SATURN is the sixth planet from the Sun and the second largest in the solar system. Saturn is a gas giant. The equatorial diameter is just over 75,000 miles.

URANUS is the seventh planet from the Sun and the third largest planet in the solar system. It is a gas giant. The equatorial diameter is almost 31,800 miles.

NEPTUNE is the eighth and last planet from the Sun, and the fourth largest planet in the solar system. It is a gas giant. The equatorial diameter is almost 30,800 miles.

The Speed of Light

Light travels in a straight line in a vacuum (which space is) at a speed of 186,282 miles per second.

So how far can light travel in one year? The calculation is not difficult: It is 186,282 multiplied by 60 (seconds in a minute) multiplied by 60 (minutes in an hour) multiplied by 24 (hours in a day) multiplied by 365.25 (days in a year). 186,282*60*60*24*365.25 = 5,880,000,000,000 miles (5.88 trillion miles). *There are 12 zeroes in a trillion.* This distance is known as a 'light-year' and distances throughout the Universe are measured in light-years. A light-year is a staggering distance, all the more so, when the outer reaches of the Universe are considered to be an enormous number of light-years away from Grange.

It is *estimated* that the diameter of the observable Universe is about 93 billion light-years, putting the edge of the observable universe at about 46-47 billion light-years from Grange. These numbers are so difficult to comprehend. Using the light-year figures above, the distance in miles from Grange to the 'edge' of the observable universe is calculated as follows:

5,880,000,000,000 miles (a light-year) multiplied by 47,000,000,000 (the number of light-years), = 276,360,000,000,000,000,000,000 miles (276.360 sextillion miles). *There are 21 zeroes in a sextillion.*

So, if a person is sunbathing in a back garden in Grange or perhaps on the shores of Lough Gur, how long does it take a ray of sunlight to arrive and gently touch the exposed skin? The calculation is simple: the time taken for the ray, upon leaving the Sun until it reaches Grange is 93,000,000 (miles to the Sun) divided by 186,282 (speed of light per second in miles) divided by 60 (seconds in a minute).

The ray of sunshine takes 8.3 minutes to arrive. When the first rays of sunlight hit the centre of Grange Stone Circle on the morning of a solstice, each of those rays of light has been travelling from the Sun for over 8 minutes.

Do you find all of this difficult to absorb? If you do, welcome to the club! But do not permit any such difficulty to deter you from being inquisitive about the Universe and from gaining more information. At a minimum, you may find it fascinating (well I hope so!), and there is always the hope that questions you may have about the meaning of life will be answered to your satisfaction, over your lifetime.

Conclusion

Dear Reader, if per chance you are sitting in an armchair while reading this book, please fasten your safety belt as you are travelling at a speed of 67,000 miles per hour through space, while orbiting the Sun!

I have compiled this article from several sources on the Internet. In so doing, I have taken reasonable precautions to ensure the accuracy of what is contained within. Several of the calculations are of my own doing. I take full responsibility for all inaccuracies arising, for which I apologise. As this is not a scientific paper, I have taken licence in so far as approximating some of the numbers.

My intention has been to offer the reader a high-level overview of aspects of the Universe including its immensity and with a context for our Solar System, Earth and Grange Parish. I have endeavoured to do so in a light-hearted and non-scientific manner.

If I have aroused your interest in the topic, please carry out further investigations yourself. You can easily mine information on the Internet to almost any level of detail that you wish. Admittedly, it is another matter to comprehend it all. However, I think that it is rather a pity to live out our lives on our magnificent planet, without gaining some perspectives on the much larger picture that is the vast Universe. You may disagree with me, in which case, I fully respect your views.

I recognise that if a Grange citizen from a younger generation decides to write a piece on the Universe, in say thirty to forty years into the future, for another Grange book, the known facts about the Universe will have grown enormously and man's exploration of outer space will have resulted in discoveries, which cannot even be contemplated now. Perhaps, in the decades ahead, a Grange man or woman or somebody with Grange ancestry will become a great scientist or astronaut, involved directly with exploration of the outer reaches of the Universe, and his or her experiences will be recorded in that parish book of the future.

If you read this article in full, you deserve a drink, you may now unfasten your safety belt!

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References and Notes

(1) Theist – Theism is the position that there is a god or gods who created the world and have interacted with it, in varying degrees, ever since. Monotheism is the belief that only one God exists. Polytheism is the belief that more than one God exists. Deism is the position that God exists, but God is not involved in the world. Source: Wikipedia

(2)Agnostic–Agnosticism is the claim that the existence of any deity (God) is unknown or unknowable; there is an absence of rational claims, based on knowledge, to support the existence of a God. Source: Wikipedia

(3) Atheism – Atheism is rejection in the broadest sense of theism, i.e. the rejection of the belief that there is even one deity. Source: Wikipedia

(4) Stephen Hawking is the former Lucasian Professor of Mathematics at the University of Cambridge and author of A Brief History of Time, which was an international bestseller. Now the Dennis Stanton Avery and Sally Tsui Wong-Avery Director of Research at the Department of Applied Mathematics and Theoretical Physics and Founder of the Centre for Theoretical Cosmology at Cambridge, his books for the general reader include "A Briefer History of Time", the essay collection "Black Holes and Baby Universe" and "The Universe in a Nutshell".

(5) NASA stands for National Aeronautics and Space Administration. NASA was started in 1958 as a part of the United States government. NASA is in charge of US science and technology that has to do with airplanes or space.

(6)A Galaxy is an enormous collection of gas, dust and billions of stars held together by gravity. One galaxy can have hundreds of billions of stars and be as large as 200,000 light years across. Source: hubblesite.org

(7) http://phys.org/news/2015-02-sun-wont-die-billion-years.html (death of our Sun)

(8) http://www.universetoday.com/18847/life-of-the-sun/ (death of our Sun)

(9) The observable universe consists of the galaxies and other matter that can, in principle, be observed from Earth in the present day because light and other signals from these objects has had time to reach the Earth since the beginning of the cosmological expansion. Source: Wikipedia

(10) Spiral galaxies get their name from the shape of their disks. In a spiral galaxy, the stars, gas and dust are gathered in spiral arms that spread outward from the galaxy's center. Spiral galaxies are divided into three main types depending on how tightly wound their spiral arms are: Sa, Sb and Sc. Sa galaxies have very tightly wound arms around a larger central nucleus. Sc galaxies have very loosely wound arms around a smaller nucleus. Sb's are between, having moderately wound arms around an average sized nucleus. Spiral galaxies have a lot of gas, dust and newly forming stars. Since they have a lot of hot, young stars, they are often among the brightest galaxies in the universe. About 20% of all galaxies are spirals. We live in a spiral galaxy called the Milky Way. Source: coolcosmos.ipac.caltech.edu

(11) As well as the sun and eight planets, our solar system contains a number of smaller planets, called 'dwarf planets', moons of other planets, asteroids and other debris.

(12) The planets in the solar system are divided into terrestrial and Jovian planets. They are different in their position, composition and other features. Jupiter, Saturn, Uranus and Neptune are the Jovian planets. Mercury, Venus, Earth and Mars are the terrestrial planets. One of the main differences that can be seen between terrestrial and Jovian planets is their surfaces. While the terrestrial planets are made of solid surfaces, the Jovian planets are made of gaseous surfaces. Source: www.differencebetween.net

(13) The density, or more precisely, the volumetric mass density, of a substance is its mass per unit volume. Source: Wikipedia

(14) Surface Gravity – the surface gravity on earth is regarded as 1.

(15) Ellipse – a regular oval shape.

(16) Gold in earth's interior – Source: thegoldlab.com/2013/12/gold-facts-much-gold-earths-core

(17) The outer planets are those planets in the Solar System beyond the asteroid belt, and hence refers to the gas giants, which are in order of their distance from the Sun: Jupiter, Saturn, Uranus and Neptune. The asteroid belt is the region of the Solar System located roughly between the orbits of the planets Mars and Jupiter. It is occupied by numerous irregularly shaped bodies called asteroids or minor planets. Source: Wikipedia

(18) Trillion – large number names have "illion" at the end of the name with a prefix at the beginning: million, billion, trillion, quadrillion, quintillion, sextillion, etc.

(19) At time of publication, the possibility of life on Mars due to evidence of water is being reported.