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“Think of the Milky Way – or search for pictures of it online – and you’ll see images of a standard spiral galaxy viewed face-on, a sprawling pinwheel of starlight and dust containing hundreds of billions of stars. These images, however, are mostly make-believe.

We know the Milky Way is a star-filled spiral galaxy in excess of 100,000 light-years wide, and we know our solar system drifts between two spiral arms at its outskirts, some 27,000 light-years from its center. But much beyond that, our knowledge fades. No space probe or telescope built by humans has ever escaped the Milky Way to turn back and take a portrait; because we are embedded in our galaxy’s disk, we can only see it as a bright band of stars across the sky. For astronomers trying to map it, the effort is a bit like learning the anatomy of a human body from the perspective of a single skin cell somewhere on a forearm. How many spiral arms does the Milky Way have, and how do those spiral arms branch and curl around the galaxy? How many stars does the Milky Way really contain? How much does it weigh? What does our cosmic home actually look like, viewed from another nearby galaxy? Ask an astronomer – and if he or she is being perfectly honest, you will learn that we do not fully know.

Among the biggest obstacles to our knowledge is the disk of the galaxy itself, particularly its center, which is thick with starlight-absorbing dust and rife with energetic astrophysical outbursts that can ruin delicate observations. This means we know very little about the other side of the galaxy.”

– Lee Billings, “Astronomers are finally mapping the Dark Side of the Milky Way,”
Scientific American, October 13, 2017

Colonizing Andromeda Galaxy: It may deeply alarm you to know that the Milky Way Galaxy will collide with the Andromeda Galaxy ... in a few billion years. On the bright side however, if we wait long enough, it will become much easier to colonize the Andromeda Galaxy.

- ✓ See, Geraint Lewis and Prajwal Kafle, “Andromeda Galaxy brought down to size for head-to-head collision with Milky Way,” repub. in Newsweek, February 15, 2018.

FTL x 10,000 LY: Imagine for a moment that Faster-than-Light (FTL) travel was available at speeds up to 10,000 Light Years – that is, the ship would travel the same distance as light does in 10,000 years, in one year. Imagine also a Galactic Empire or other centralized galactic civilization existed – actually spanning the galaxy and not just a handful of local stars – and that the speed of ships was the fastest form of communication available.

The Milky Way Galaxy is approximately 100,000 LY across. Such a situation would mean that it would require 10 years (at best speeds, not counting any necessary stops or detours around the massive black hole in the center of the galaxy) for news, goods, and government actions or directives, to cross the Galactic Empire from one side of the Milky Way to another, going across the center. Any deviation in the route of the ships only adds more light years to the communication.

- ✓ See previous discussion of FTL communications in Communications Breakdown, 1 The Streams of Time, p. 76, *supra*.

By contrast, on Earth, because of the current technology, the communication lag is almost negligible for news and directives transmitted electronically, and only a matter of days for the normal movement of goods and services even for the largest developed nations. The time-zone differences cause more delay – due to the human need for sleep – than any distance consideration. In

the 19th Century, the delays could be weeks or even up to three months, but with less population density and lower overall complexity, central governance was possible.

In terms of the universe, 10 years is a millisecond of a millisecond of a nanosecond; but for human lives, and human governance, that's an incredible amount of time to wait for anything.¹ My ship of the imagination has crossed the Milky Way twice, out and back, and is on its way out-bound again, approaching the center of the galaxy, since the day I started this project.

✓ Read it on a t-shirt: “Come over to the Dark Side. We have cookies.”

- Transatlantic Communications: GGDM is now out in the marketplace of ideas. Most ideas end up in the ‘wastebasket of history’ (Montross). For example, one of the proposed solutions to the transatlantic communications problem was to create a line of anchored signal barges, manned by one sailor each, to relay signals by lamp or flags across the Atlantic. I am sure that the person who seriously suggested this was not volunteering for barge duty! The solution was the investor-funded transatlantic telegraph cable in 1858, which reduced England to Canada communication time from 10 days to hours – it worked for 3 weeks then failed, but two new cables were working by September 1866; in the early 20th Century, transatlantic telephone by radio was established (by which Churchill spoke to Roosevelt).

Through undersea cables, the entire British Commonwealth was eventually connected around the globe, this network made *the capture of London* (more precisely, Porthcurno Cable Station in Cornwall) desirable to the Germans in WWII – this issue is never discussed in WWII histories as a strategic objective. The HyperPulse Generator arrays in BattleTech serve a similar role and may have been inspired by the transatlantic cable and radio telephone.²

- Let's Do Some Calculations: The Milky Way Galaxy – probably just an average galaxy – has *about* 100 billion solar masses, translating to 100 to 400 billion stars (depending on what is the average solar mass per star other than our own).³ And there are *two trillion galaxies* according to a 3D model recently created from Hubble Telescope observations.⁴ Carl Sagan, in Episode 1 of *Cosmos* (filmed 1978-1979, aired 1980), opined, “There are a hundred billion galaxies and a billion trillion stars.” Thus our estimation of the size of the universe has increased by 20 times in about 40 years. We have become 20 times more *insignificant* since the height of the Cold War.

✓ Yes, this is a glass half empty or glass half full of water/air moment. Someone from the Sagan camp will surely say that makes us 20 times more significant and the Earth and humanity more precious not more insignificant. But let's just say that we've gone from a being a pixel on an 8mm film to being a pixel on a 4K screen. Math doesn't lie so they say, the weight of the negative analogies always exceeds the positive and the spiritual.

This issue brings back to the fore a problem called Heinrich Olber's “dark sky paradox,” which asked, based on the number of stars in the sky, even though they are all very distant, considering the age of the universe, why isn't it light at night?⁵ A little humility would go a long way in space.

A recent study by UCI and LIGO (observatory) published in August 2017 suggests that there are upwards to 100 *million* black holes in the Milky Way Galaxy.⁶ That seems like a lot, it seems like if we turn around, a black hole might be sneaking up behind us! But considering the scale of the Milky Way Galaxy – at least 100 *billion* stars, the black hole problem isn't

really a problem, as there would be just one black hole for every 100 to 400 stars in the Galaxy. But it might make for a very interesting transit system...

The International Space Station (ISS) orbits at **250 miles** above the Earth (low Earth orbit), that's about the distance of a daily commute from Pittsburgh to Philadelphia, except, of course, the problem is that it's straight up (more or less). The equatorial circumference of the Earth is **24,901 miles**. The Moon – good 'ol Luna – is just about **238,900 miles** away, about 9.59 times the equatorial circumference of the Earth – most of the lunatics are much closer, unfortunately. It would take *about* 33 years to walk to the Moon (at a rate of 20 miles per day, 7,300 miles per year, with a few days off to watch the World Series or World Cup), or more accurately, to walk to the spot in space where the moon will be in 32.726 years. Mars is **39 million miles** away at its closest (remember your orbital mechanics); we have a lot of work to do to put a person on Mars. Asteroid Florence, just 3 miles wide, will pass by the Earth at a very close range of 4.4 million miles in September 2017.⁷

*“There was a young lady named Bright
Whose speed was much faster than light
She set out one day
In a relative way
And returned the previous night.”⁸*

Engage!: Interstellar movement requires a starship, there is no technology which allows movement of *anything* in the 1st Era (at the least) without a starship (or System Boat if in-system movement). All interstellar movements that are not initiated by activation of the Expansion Power, Combat Power or Commerce Power, require the activation of the Movement Power.

Specifically:

- 1) Any ship **that is not carrying population** (e.g., not Colony Ships, Troop Transports),
- 2) That is departing from *any* origin system,
- 3) To any destination system that is currently colonized by the ship's owner (other than by ownership of Conquered Colonies, see Supporting Colony, next page, *ut infra*),
 - In this context, “colonized” means having a colony in the system, regardless of colony political status (except Conquered Colonies) or native population type.
- 4) Where the departing ships are either unable to or do not intend to initiate combat upon arrival,
- 5) Requires an activation of the Movement Power.

These conditions precedent must exist *only at the moment of departure*.

A specific set of conditions precedent exists – detailed appropriately in each rules section – for each of the four Power Activations that can initiate interstellar movement. The Movement Power is activated for initiation of movement that does not fit the conditions precedent for initiating interstellar movement under the Expansion, Combat, or Commerce Power, *ut infra*.

- **Ad Astra:** All ship movement occurs in the Galactic Space. Activation of the Movement Power allows as many eligible ships as desired to *depart one starsystem* to **any number** of

destination starsystems. One Act and one Scene *on the star of the origin starsystem* is required to activate the Movement Power for all ships in a system that are departing in the same turn. All types of ships may use the Movement Power activation to move, including warships; warships do not automatically require an activation of the Combat Power to move.

- ✓ Despite the fact that ships appear on the Public Space – that is, they are within the consciousness of civilization – they do not move on the Public Space and the Public Space has no effect on their movement (other than the Scene requirement). See also Buzzing Lightyears discussion in 4 The Streams of Time, p. 101, *supra*.
- Flying Dutchman: Because of the uncertain time periods represented by a Regular Turn, it is not prohibited for a ship to perform interstellar ‘short’ movement to more than one destination star in a Regular Turn (or more than one action per turn) by appropriate multiple Power Activations and if Scenes have been previously placed. See Space Hop, 2 Movement, p. 850.
- Engines Offline: Each ship that is ordered to move by activation of the Movement Power must be checked to see if it fails to obey the Power Activation due to inactive Constructural Elements on the ship (see Power Off, 2 Constructural Elements, p. 193, *supra*). A ship that fails to obey the Power Activation does not move, even if other ships at the same location depart due to obeying the Power Activation. If the ship that fails to obey the Power Activation is located at a Supporting Colony system, a **second check** is made using the Supporting Colony’s Constructural Elements and if successful, the delinquent ship obeys the Movement Power Activation and departs as normal. An attempt may be made for each Supporting Colony in the system. This applies only to *failed* Power Activations related to ship movement.⁹
 - ✓ For example, a warship and a Log Ship are ordered to Move from Colony A to Colony B (both owned by their position) by activation of the Movement Power at Colony A. The warship obeys the Power Activation but the Log Ship does not (*sound of FTL engines cycling down*). No Enlightenment was dedicated for the Power Activation. A second check is made using Colony A’s current Constructural Elements (Colony A has only one inactive Constructural Element so only a 15% chance of failure) and the colony passed, so the Log Ship departs as it should have (e.g., the captain was arrested by the *chekist* First Officer on the bridge and handed over to the colony for ‘reeducation,’ order was restored by ship security, there were a few casualties).

“A ship in the harbor is safe, but that’s not what ships are built for” – Old maritime saying

UniSIM: Although many units will begin movements by the activation of other Powers, all ship movement follows the Standard Interstellar Movement (SIM) rules and the movement formula and current Ship Speed of the Stardrive Patent they are using. Movement by activation of the Expansion Power or the Combat Power are merely representative of extra preparation and intent in beginning of movement to expand or to go into a potential combat situation, otherwise, movement follows standard rules from the time they depart the origin until they reach the destination. The Movement Power is only activated when ships are departing from a supporting colony system to a destination where there is also a supporting colony.

- Supporting Colony: The term “supporting colony” refers to any Friendly, Converted, or Naturalized Colony, including Low Population Colonies (see 4 Taxation & Census, p. 326, *supra*) which is owned by the owner of the ships in question (at the time of departure), that will

automatically resupply the fleets on arrival (see Free Resupply, 3 Construction, p. 678, *supra*, and Operational Supply Limitation, 3 Movement, p. 856 *infra*). A Conquered Colony is not a supporting colony until it is Converted (see Conquered Colony, 2 Order, p. 539, *supra*).

- ✓ A Besieged Colony (see 3 The Sidereal Stage, p. 124, *supra*) or colony currently involved in Colony Combat at the time that the Regular Turn is processed cannot act as a supporting colony. This could be catastrophic as discussed in The Cold Equations, 3 Movement, p. 864, *infra*; ships arriving at the colony may be forced to run the blockade (see Blockade Running, 4 Commerce, p. 1233, *infra*).
 - ✓ As noted in 3 Construction, p. 678, *supra*, the ‘free resupply’ at Supporting Colonies does not require a Power Activation, and thus cannot be affected by Constructural Elements status on either the colony or ship.
 - ✓ As noted in Dark Tea, 2 Temporal Technology, p. 821, Surreptitious Entry, 3 Temporal Technology, p. 828, *supra*, T-Ships (Temporal Ships) do not automatically resupply at a friendly colony unless they reveal their presence. T-Ships must always attempt surreptitious entry when arriving at the destination system.
 - ✓ Supporting Colonies also often provide a second/back up check when starships initiating interstellar movement fail to obey the Power Activation, as described above and in Canned Food, 3 Expansion, pp. 913-914, Move Out!, 1 Combat, p. 942, Before You Go, 1 Commerce, p. 1189, and Blockade Running, 4 Commerce, p. 1233, *infra*.
- History Again: Supporting colonies are historically analogous to the 19th Century naval need for coaling stations, and before that, in the Age of Sail, the need for ports to obtain fresh water and food, and repairs. There is a reason why sailors were notorious for alcohol consumption and for ‘spending like a sailor’! Thus, the need for ports drove colonial expansion, trading strategies, diplomacy, and shipbuilding, over the course of several centuries. One of the factors behind the Commodore Perry Expedition to Japan, 1852-1854, was the U.S. concern that the European powers had already monopolized the coaling locations across the Pacific, giving them an advantage in war and trade. *The opening of Japan to the West never was about Japan’s wellbeing from the view of the Western colonial powers*; no one asked how this would affect Japan’s economy, culture, or political environment. And Japan got a cholera epidemic from it as well. Conversely, the European powers were very concerned that the U.S. would obtain exclusive trading rights in Japan and soon forced themselves upon Japan’s tottering government as well, extracting treaties and concessions.
- Interstellar Chess: Strategy is in large part, but not exclusively, about position, Chess is a game of position, business people talk about market positioning of their products and services, baseball managers use ‘defensive shifting.’ I backed the board game Blueshift on Kickstarter, and in May 2019, finally was able to play two games at the game club.¹⁰
- ✓ The first game was a terrible experience where I was completely out of position at the end of the game, unable to do anything at all. I ended the game turtling in the corner just to make sure the two big players had to fight each other to win instead of one of them winning by knocking me out.
 - ✓ The second game, I was able to place units and time my attack toward the center of the board late in the game, first defeating a player who was in the space I attacked, and then I turned and attacked from the space I had won into a space owned by a second player who was poised to win the game on his next turn. It was small consolation

to the player I had to victimize initially (and who had no chance of winning), but had I not been in that position (space), I would not have been able to take a shot at stopping the guy who was about to win the game. I did win the second battle as well, but the other players on their turns were unable or unwilling to do anything effective and I finished in close second, first loser, position in the second game. Of course, my war wasn't their war, my success would have only prolonged the game which they had no chance to win and little to gain, so it was my battle and up to me to succeed or fail.

For whatever a position needs or thinks they want to do in GGDM, the position's ships will need to be in the right place (spatially), at the right time, with sufficient support, whether it is technology, material enhancements or logistics. Ship, asset, and colony placement for the future should always be a consideration in Power Activations throughout the entire game; it is a sad game of catch-up if Power Activations are being used to scramble in reaction to a sudden emergency.

- ✓ **John Connor:** We're playing that most American of games. **Web Smith:** Which is what? **John Connor:** Catch up. – Rising Sun (1993).

“Any belief that puts itself beyond doubt nurtures its own collapse.”

– Stephen R. Donaldson, [Reave the Just and Other Tales](#) (2000)

Gap Info: And then there is that ‘leap of faith,’ a most curious human term. Consider this usage note from Merriam-Webster online dictionary at *faith*: “Belief, faith, credence, credit mean assent to the truth of something offered for acceptance. Belief may or may not imply certitude in the believer. Faith almost always implies certitude even where there is no evidence or proof. Credence suggests intellectual assent without implying anything about grounds for assent. Credit may imply assent on grounds other than direct proof.”

- ✓ I was talking with a Traveller RPG aficionado at the game club in July 2019. I was discussing the Sandcaster Turret defense system on ships; it is one of those sci-fi ideas that seems good at first glance but is less and less practical the more you think it through. The conversant pointed out that it remains in the current game (40 years later) because it is the only defense system for ships against laser turret weapons in Traveller, then surprised me somewhat by adding that we just have to have faith in the game system and accept that it is something that works!

I have argued throughout GGDM (e.g., see Assumptions of Light, 1 Stardrive, p. 781, *supra*) about having to accept certain future technologies (and conditions) as *necessary premises* or assumptions of the game setting (e.g., faster-than-light travel, drive to colonization, Government Titles) and that they must be accepted hypothetically on the basis that we cannot possibly predict the long-term course of future technology, its capabilities, and social effects because they are non-linear (see Uber Alles, 2 Eras, pp. 767-768, *supra*), that is, *emergent* (a view also held by Vernor Vinge, who invented the ‘technological singularity’ term, see feature quote, 2 Technology, p. 705, *supra*). *Necessary premise* is a major resident of science-fiction stories, which it probably inherited from fantasy – any story involving gods, evil, and magic must have them as a necessary premise or the story is nonsense – which fantasy probably learned from religion – all religions (and love) are castles in the sky *built on the clouds of a necessary premise*.

However, ‘faith’ is never a word that entered my thoughts in accepting the seemingly implausible future technologies of GGDM or of any other space-opera game or interstellar setting; what I have described is not the normal use of faith, it is necessary premise or background assumption, more similar to how Merriam Webster described ‘credence’ or ‘credit’ (*ut supra*). Perhaps that is a window to my current concept of faith? Perhaps my concept of faith is a bit narrower, a bit scrambled vis-à-vis others? Or perhaps what he meant was that we must accept Sandcaster defense as a necessary premise in a game that features starship combat with lasers? Ok, but I have never seen Sandcaster defense anywhere but Traveller (because it is operationally problematic), but I have seen lots of laser starship battles in movies, sometimes with convenient (and very questionable) ‘force fields’ for defense and sometimes with no apparent defense except ship hull armor, speed, and maneuver.

- ✓ “Force fields or screens? Well, again, they climb in the face of the electromagnetic theory. You can’t make the expanding wavefronts of a wavefront stop expanding. No.” – James Blish, *The Tale that Wags the God* (1987), Kindle Locations 598-599.¹¹

But then a few days later, I read an article from the MIT Technology Review wherein the author made the following Asimovian statement:

- ✓ “This raises mind-boggling questions. As the technology advances, we might soon cross some threshold beyond which using AI requires a leap of faith. Sure, we humans can’t always truly explain our thought processes either – but we find ways to intuitively trust and gauge people. Will that also be possible with machines that think and make decisions differently from the way a human would?” – Will Knight, “The Dark Secret at the Heart of AI,” MIT Technology Review, April 11, 2017.

Now, this is a different meaning of faith, closer to what is meant by religion, as is indicated by the next sentence. Can we make the ‘leap of faith’ into something built by us – in whom we have little faith, despite our ability to “intuitively trust and gauge people” – into ‘Deep Learning’ AI that is opaque to us, and that may be better or smarter than we are? That is the technological singularity problem. Will it see the existential void as we do, or laugh at us as pets, children?¹²

“Astronomers have discovered the oldest supermassive black hole ever found – a behemoth that grew to 800 million times the mass of the sun when the universe was just 5 percent of its current age, a new study finds. This newfound giant black hole, which formed just 690 million years after the Big Bang, could one day help shed light on a number of cosmic mysteries, such as how black holes could have reached gargantuan sizes quickly after the Big Bang and how the universe got cleared of the murky fog that once filled the entire cosmos, the researchers said in the new study. Supermassive black holes with masses millions to billions of times that of the sun are thought to lurk at the hearts of most, if not all, galaxies. Previous research suggested these giants release extraordinarily large amounts of light when they rip apart stars and devour matter, and likely are the driving force behind quasars, which are among the brightest objects in the universe.”

– Charles Q. Choi, “Oldest Monster Black Hole Ever Found Is 800 Million Times More Massive Than the Sun,” Space.com, December 6, 2017

Endnotes.

¹ Citation: "...you know there is a ten year delay in the Soviet Union for the delivery of an automobile. And only one out of seven families in the Soviet Union own automobiles. There is a 10 year wait, and you go through quite a process when you are ready to buy, and then you put up the money in advance. This man laid down the money, and the fellow in charge said to him: Come back in 10 years and get your car. The man answered: Morning or afternoon? And the fellow behind the counter said: Ten years from now, what difference does it make? And he said: Well, the plumber is coming in the morning." – Pres. Ronald Reagan (video available on YouTube), "Ronald Reagan tells Communist Jokes," Popular Science, December 3, 2012.

² Citation: "A 2018 study in the American Economic Review found that the transatlantic telegraph substantially increased trade over the Atlantic and reduced prices. The study estimates that 'the efficiency gains of the telegraph to be equivalent to 8 percent of export value.'" – from Wikipedia article, "Transatlantic Cable," April 25, 2020.

- ✓ This is a historical example to consider when thinking about the possible economic impact of industry and communications technology development in GGDM, or even FTL Communications or lack of as discussed in 1 The Streams of Time, *supra*.

³ Citation: Elizabeth Howell, "How Many Stars Are in the Milky Way Galaxy," Space.com, May 21, 2014.

⁴ Citation: Andrew Griffin, "Universe is far bigger and more stuffed with galaxies than previously thought, scientists reveal," Independent UK, October 14, 2016.

⁵ Citation & Commentary: Ian Johnson, "Astronomers prove 200-year-old theory about why it gets dark at night," Independent UK, October 14, 2016. Remember that a paradox is "a statement that is seemingly contradictory or opposed to common sense and yet is perhaps true" (from Merriam-Webster online dictionary).

- ✓ A curious side case is a sub-giant metal-poor star labeled HD 140283 located 190 LY from Earth, which has consistently been dated as being older than the universe. How can that be? Should theists celebrate? The problem with the problem is that dating both has been a moving target, both the age of the star and the age of the universe have been shifted a few hundred million years this way and that during the time we have tried to figure out the star's age. It is certain that we have got something wrong in our methods, but that doesn't automatically mean that the star is not older than the universe....

⁶ Citation: University of California, Irvine, "UCI Census indicates that black holes pervade the universe," published in phys.org, August 8, 2017.

⁷ Citation: Ryan F. Mandelbaum, "Closest approach ever by a large asteroid won't end life on Earth, but probably should," Gizmodo, August 18, 2017.

⁸ Citation: Anonymous limerick of unknown interstellar origin. Probably written by a bored physics undergrad on Sol Three.

- ✓ The limerick appears on the bottom of Page 31 of the May 24, 1963 issue of Life Magazine (of which I have a collector's copy) where it is challenged as being untrue (Albert Rosenfeld, "A 3,000,000-year Trip in Only 55 Years," pp. 28-34). This provides a historical date of usage.

⁹ Commentary: The Royal Navy mutinies of 1797 at Spithead and The Nore are the *essence* of inactive Constructural Elements causing Power Activation failure on ships. And the *example* of a Supporting Colony second check. Compare this to the results of the famous Mutiny on the Bounty (1789) or the Batavia Mutiny (1629) far from port.

¹⁰ Commentary: The boardgame Blue Shift (2017) is an interesting and well-play-tested game. Unfortunately, the rules could have been better written and edited. The young man who wrote the game rules has not learned to edit; editing requires stepping outside of yourself: It doesn't matter what is in your head, it is what is on the page that counts in game rules or legislation (readers of GGDM might think I took that rather to an extreme). He obviously knew things about the game that he failed to make clear in the rules (in addition to the obvious typos, and other editing issues), but eventually, we figured it out.

¹¹ Commentary: The implication of force fields and screens, as James Blish expressed it, is some kind of time stop technology or temporal stasis at work – that is the only way to make expanding wavefronts stop expanding in space – short of striking something else – is a temporal effect.

- ✓ As has been noted previously (see Assumptions of Light, 1 Stardrive, p. 781, and Thumbing Our Nose at Einstein, 1 Temporal Technology, p. 802, *supra*), in order to have FTL without time-dilation effect, one must assume that they have developed some primitive level of temporal technology.

¹² Citation: See The AI Problem excerpts, Corporations, *infra*. See also Dave Nilsen "Duck Test" excerpt, *Id*.