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"For one thing, there was a convention among the authors of those days that since the solar system lies approximately in a flat plane (the plane of the ecliptic), the only way you could get from one planet to another was by traveling along that plane. This meant that if you were attempting to go any distance beyond the orbit of Mars, you were involved in an awful lot of banging and clashing about among the asteroids. My favorite example of this comes from a somewhat later period – a story by Sam Moskowitz in which the hero, in order to reach Saturn, finds himself necessarily banging and clashing his way through the planet's rings.

Now, if there is a more avoidable astronomical object in the solar system than the rings of Saturn, I do not know what it is! But there was this flat plane convention; and we were stuck with it. It took me a long time to learn from science fiction that space happens to be three-dimensional, and that in order to avoid the asteroid belt all you need is a slight expenditure of fuel and you can go over it!"

– James Blish, The Tale that Wags the God (1987) (Kindle Loc. 492-500)

Interplanetary Movement: Interplanetary Movement occurs when the origin and destination stars are the same, that is, between planets orbiting the same star, and does not require the activation of any Powers, thus it *occurs before any Action that requires the activation of a Power*. See Clockwork Universe, 3 The Streams of Time, p. 90, *supra*, regarding normal order of Regular Turn actions processing. It is assumed that all positions have accomplished efficient interplanetary travel before the start of the game. Movement of ships, boats, and fighters between system space and planets in the same system is ***instantaneous***, and will be executed secretly unless another position's colony or ships are present. Interplanetary Movement may not occur between planets owned by the same position if any of the colonies in the system owned by that position are besieged (see Blockade Running, 4 Commerce, p. 1233, *infra*).

- ✓ Thus Homeworld and Lost Colonist positions may automatically colonize all available planets in their systems before the game begins.

Activation of the Expansion Power for the purpose of Transporting Populations (see Colonization, 1 Expansion, p. 876, *infra*) is only necessary for *interstellar movement* of colony ships (i.e. to another starsystem). Loading and Unloading or Landing colonist after *interplanetary movement* will still require Expansion Power activations regardless of distance moved.

- Gray Space: There is some possible gray area here; the Interplanetary Movement rule was written assuming the usual (in our provincial view) single star with a host of planets, rocks, Tesla Roadsters and comets orbiting. If binary systems are specifically introduced into the game, especially those that have separate planetary systems, it may require a ruling as to whether the stars are within interplanetary movement distance.
  - ✓ For example, Alpha Centauri A and B are binary stars that orbit around a common center point every 79 years; the distance between the two stars is interplanetary (that is, within the distances between the Sun, Saturn, and Pluto). Alpha Centauri C (also called *Proxima Centauri*) is a red dwarf, orbiting Alpha Centauri AB at .21 LY distance. Interplanetary movement range in GGDM or FTL?

Would movement from a planet in Alpha Centauri AB to Alpha Centauri C be interplanetary movement (possibly with a one turn delay) or would it require stardrive? (Information was gathered from Wikipedia articles, "Alpha Centauri" and "Binary Star," June 10, 2018.) This is important not only for Power Activations but for system boats. GGDM is over-simplistic, its star and world generation rules are set at the lowest common denominator of space-opera sci-fi writing and fandom, systems such as Alpha Centauri (our closest neighbor) show levels of detail that can be added to the game terrain of Galactic Space if desired.

- Ships in Port: Normally, it is not important which planet ships in a system are located at; it is assumed that ships which are on a star occupy all of the system's space as their 'zone of control.' Thus ships in a starsystem are never assigned a planet at which they are located, unless they have specifically moved there or taken shelter at the planet (e.g., retreats from Ship Combat, see The Better Part of Valor, 3 Combat, p. 981, *infra*, and Blockade Running, 4 Commerce, p. 1233, *infra*) but are instead placed on the system's star in the Public Space for as long as they remain in the system.
    - ✓ Zone of Control (ZOC) is a 1960s wargaming term that means the unit's ability to project military power and movement control into adjacent spaces on a flat hex map to hinder the enemy's ability to use that space. In GGDM, it is congruent with the assumed ability to be anywhere in system space effectively 'instantaneously' within the time frame of a GGDM turn; that is, it may take days, weeks or months in real time.

Conversely, in the DUST sci-fi short, "FTL" on YouTube (written & directed by Adam Stern, 2017), the experimental FTL ship moved from Earth to Mars in about 3 minutes, and somehow was able to just stop instantly (*à la* Star Trek warp drive) without ill effect on the pilot, e.g., being thrown through the cockpit glass at FTL speeds. Not to mention being squashed into subatomic particles by the initial FTL acceleration. And there was no time dilation either. But this technology may also be assumed in GGDM.

Einstein: *There is no coordinate system that is principally preferred by its simplicity; thus there is no method to distinguish between 'real' and 'non-real' gravitational fields.*

Palagyi: *The discussion between Einstein and Lenard has made a deep impression upon me. One encounters here again the old historic opposition between experimental and mathematical physics, as it already existed between, for example, Faraday and Maxwell. Mr. Einstein says that there is no preferred coordinate system. But there is one. Let me think biologically, then any man carries his coordinate system within himself. In the course of this thought, a refutation of the theory of relativity is contained.*

Mie: *I never understood, that the view in which the aether was essentially the same as seizable matter, should have been only discovered by the theory of relativity. This was already done long before by Lorentz in his book 'electrical and optical phenomena in moving bodies.' Also Abraham in his textbook, in the time when he was still in opposition to the theory of relativity, said: 'The aether is empty space.' I'm of the opinion, that even by approving Einstein's gravitational theory, one has to distinguish between mere fictitious gravitational fields, that one introduces into the world by the choice of coordinate system, and the real gravitational fields that are given by objective facts. I have*

> *recently shown a way, how one arrives at a 'preferred' coordinate system, in which all fields that are only fictitious are excluded from the outset.*
>
> **Einstein**: *I cannot see, why such a preferred coordinate system should exist. At most one could think to prefer such coordinate systems, in relation to which the Minkowskian expression for ds^2 is approximately true. But neglecting the fact, that such systems do not exist for extended spaces, such coordinate system are surely not exact, but can only be defined approximately.*
>
> – from *Allgemeine Diskussion über die Relativitätstheorie (1920), Physikalische Zeitschrift*, 21, pp. 666-668, English translation on Wikisource at "The Bad Nauheim Debate"

Cubed Space: The concepts for understanding the position of the stars, calculating movement distance and time, and understanding the Starlog are singular for the game. All positions use the same system of Galactic Space coordinates.

That is, while the Public Space is subjective, Galactic Space is objective, necessarily universal. *Sort of* like the debate above between fictitious and objective gravitational fields in relation to coordinate systems.

- Positional Value: The initial playing area is a cubic section of Galactic Space and the Positional Value of each star, found on the Starlog next to the star's name, is that star's physical location within the playing area. In order to simulate the three-dimensional aspects of the playing area, each star's Positional Value is expressed as a set of numbers labeled X, Y, and Z. Positional Values are used to calculate the movement distance between stars. The method of calculating distance between the origin and destination stars is expressed in the Movement Formula section of the Stardrive Patent whose stardrive system the starship is using.
  - ✓ See How it Moves and Blurry Hurry!, 2 Stardrive, both p. 794, *supra*, regarding movement formula requirement of Stardrive Patents.
- Real Space: Positional Value is the location of the star system in 'real space' aka the Galactic Space in GGDM. The arrangement and relationship of the planets and stars in the Public Space bears no relation at all to the actual positions of the stars and planets in the Galactic Space and are not used in calculation of movement distances. Ships may move, using non-Movement Power Activations, to stars that are not currently in the Public Space; *ships cannot move to* star locations that are not in Galactic Space (i.e. not on the current Starlog).

  Because of the conditions precedent to initiate interstellar movement via the Movement Power Activation, ships *may not move to* stars using a Movement Power Activation that are not also currently on the Public Space of the position. While it might be tempting to read meaning into this, it is generally just a consequence of the game mechanics, and does not create any correspondence relationship between the Public Space and Galactic Space.
- Disturbulence: There may be space-time Disturbulence around each star; this Disturbulence is expressed as a Disturbulence Modifier which forms a kind of terrain in Galactic Space. The Disturbulence Modifier of each star is particular to each Stardrive Patent and is unknown until a ship with that type of stardrive enters the starsystem for the first time (making Scouts very expendab—err, valuable).

Turbulence occurs in the atmosphere of a planet, or on a body of liquid, Disturbulence occurs in space-time. Because space is so...'thin' only ships travelling at FTL speed encounter 'Disturbulence' when approaching a star's gravity well. Possibly, FTL travel wounds or damages the universe, FTL drives put forth a tremendous amount of power bending space. True sublight drives probably don't encounter disturbulence. Anyway, that's the game mechanical excuse for this rule...

- ✓ Homeworld systems will never have a Disturbulence modifier for the very first Stardrive Patent obtained by that position as it is assumed that the scientists would have developed and tuned their first stardrive based on the properties of the system space around them. Homeworlds are only special to their starting position and may have Disturbulence Modifiers for other position's Stardrives.

The Concierge determines the Disturbulence Modifier for each star at the moment that a ship of that stardrive type attempts to enter the star for the first time. The Disturbulence Modifier for each star will be expressed in either *extra turns of movement required to enter the star*, or *extra movement distance*, or both. In short, Disturbulence modifiers cause ships to not arrive when expected, at least for the first ships going to that system, but can be accounted for later.

- ✓ ***Temporal Disturbulence*** (extra turns) is very difficult to overcome, however spatial Disturbulence (extra movement) may be overcome by increasing Ship Speed through continuing research (see Dog Star and Spindizzy, 2 Stardrive, both p. 792, *supra*).
- ✓ Temporal Disturbulence Modifiers are usually assumed to add extra turns, but it's not impossible that they may rarely make movement to a starsystem faster by subtracting a turn from the flight; that is, the star system seems to reach out and pull the ship through a 'barrier,' (mythopoeicly speaking?) skipping it ahead in time.

Disturbulence Modifiers are one of the major tools to shape the Operational Characteristics of the Stardrive Patent (see 2 Stardrive, p. 795, *supra*); it is suggested that the Stardrive Patent establish standard die roll ranges for the Disturbulence Modifiers.

- ✓ For example, some stellar classes (see Stellar Classes, 2 Expansion, p. 898, *infra*) might be more difficult to approach than others with a particular Stardrive (for reasons unknown, unknowable based on our current understanding, but probably related somehow to the color dots in the Merchant of Venus (1988) board game)?

Again, it bears repeating that balance does not mean no advantage gained, but rather that the advantage gained from the effort of making a new Stardrive Patent should be consummate with the effort required and should not wreck the game by being overpowered; lastly, the stage of the game should be considered.

- ➢ Starlogs: Each position will have its own running Starlog. All position Starlogs will contain the same coordinates, star colors and other basic *universal information* as well as links to the display for each star. Upon determining the Disturbulence modifier for each starsystem, the Concierge will record it permanently on the position's Starlog. Once recorded, the Disturbulence modifier for each star for each stardrive, probably won't change. You cannot change space or time, you can only change your stardrive, by either improving it, or abandoning it. Subsequent movement to the star will take into account the known Disturbulence Modifiers.

"Spacetime tells matter how to move; matter tells spacetime how to curve."

– John Archibald Wheeler, Geons, Black Holes, and Quantum Foam (1998), p. 235

Standard Interstellar Movement (SIM): Apparently the universe is a twisted place.

Humans, tiny minds living on our tiny primal planet, have no real concept of how big space is (we don't *grok* it); we just don't have a common *non-scientific language* which conveys the emotional, cognitive distances of space, not only between the stars, but even within our own system space. The truth is that distance really doesn't matter in space (and is not determined with any degree of precision in this game); all that matters is speed and time and how to live long enough to arrive at the destination. Time is more important than distance in interstellar space (and our lives) and humans don't live long enough to truly appreciate it.

- Groundhogs: Most of our interstellar science-fiction settings continue to reflect our provincial 'groundhog'-view of interstellar space. This is necessary, perhaps, for the audience and to keep the story humanly manageable. It's like explaining to a landlubber the vastness of the Pacific Ocean; you just cannot imagine how vast is the Pacific Ocean until you have been on it onboard ship, flying over it doesn't do it justice, you have to *feel* the vastness; similarly, the Midwest and Great Plains in the United States are called 'fly over country' because that is what most people do, flying from city to city, coast to coast. Dr. Paul Mason of Duquesne University suggested to the class that the current concept of divinity did not develop until Europeans began sailing the deep oceans. FTL transit as usually portrayed, would not allow us to feel the vastness of space (sunlight takes 8 minutes 20 seconds to reach the earth, *five hours to reach Pluto*), rather, it is movement from point to point, star to star:

  - ✓ "That would be because of warp speed, which for present purposes consists of looking through an unnecessary window at bright lights zapping past. This method of transportation *prevents any sense of wonder at the immensity of outer space* and is a convenience not only for the starship but also for the screenwriters, who can push a button and zap to the next scene. The concept of using warp speed to escape the clutches of a black hole seems like a recycling of the ancient dilemma of the rock and the hard place. ... Lots of verbal commands seem implausibly slow. Consider, at light warp speeds, how imprecise it would be to say 'At my command ... 3 ... 2 ... 1 ...' Between '2' and '1,' you could jump a million galaxies." – Roger Ebert review of Star Trek 2009, May 6, 2009 (emphasis added).[1]

  Consider this casual gripe between friends: "I spent three hours driving in a hot car with three amped-up kids, get to the show and found it was canceled, then had to drive back home." The typical response is likely a commiserate, "Ugh!" How many times do we casually substitute time for distance?

  - ✓ "Time is perhaps our prime yardstick. The distance to a friend's home is generally calculated by how long it takes to get there rather than by the number of actual miles it is, for time is the reality given varying road, traffic and weather conditions, and alternate routes, and distance isn't, not really.... we surround ourselves with realities that depend on one other dominant reality, the inexorable passage of time, a precisely measurable phenomenon." – Roger Caras, A Cat is Watching (1989), p. 194.

How much of our appreciation of distance and work is expressed emotionally rather than with Lockean precision?

- Time & Space: Standard interstellar movement is simply the amount of time, in Regular Turns, that is required for starships leaving the origin star to arrive at the destination star, taking into account Disturbulence Modifiers. Disturbulence Modifiers are only ***applied when entering the star***, not when leaving it, entirely for sake of convenience in play. Time of movement is calculated as the movement distance (calculated as described on the ship's Stardrive Patent) divided by the speed of the ship. Movement of the ship is then tracked solely in terms of the number of turns elapsed between the time it left the origin and until it arrives at the destination; the Concierge does not keep or record the current X, Y, and Z coordinates of any ship in interstellar space as they are irrelevant to the game (unless it is important to a story event).
- The FTL Missile: A starship leaving on an interstellar voyage becomes, in effect, a missile traveling between stars at, presumably, faster than light speed. Thus, it is always assumed that starships depart at the maximum Ship Speed allowed by the current Stardrive Patent for that ship's Stardrive type, and that they travel in a straight, uninterrupted line toward the destination at a constant speed (constant speed is assumed for game convenience).
    - ✓ Starships in interstellar flight will not obey new Power Activations until they arrive and do not require additional Power Activations to continue moving each turn.
    - ✓ Starships *en-route* to a destination star may not change destinations or ship speed, stop, alter course, or interact with or engage other starships in FTL combat in interstellar space. A ship also *cannot avoid* entering/arriving at the destination starsystem.
    - ✓ Improvements in ship speed will not affect the travel time of a ship which is *en route* to a destination star at the time of the improvement.
    - ✓ It is possible to design Stardrives which do not travel at a constant speed (for example, starts slow, gains speed), and this will be allowed by the Concierge only if it is fitting, useful, and/or interesting for the particular game or helps to balance the operational characteristics of the Stardrive Patent. It is also possible to design Stardrives which allow ships to depart at less than maximum Ship Speed (but why?).
    - ✓ Since the coordinates of ships are not recorded when they are between stars, there will be a *very strong presumption of un-playability* against any attempt by positions to create technologies or Stardrives that allow ships to change destinations or ship speed, stop, alter course, or interact with or engage other starships in FTL (or hyperspace or whatever) combat.

It is not impossible to imagine an FTL movement system that requires complete stops in deep interstellar space. For example, the Jump Circuit in Norman Spinrad's The Void Captain's Tale (1982) implies that the ship is stopped in interstellar space for a time after each jump:

- ✓ "At the other side of quite literally immeasurable temporal discontinuity, the ship 'comes out' of the Jump an average of 3.8 light years away and most often roughly along the desired vector." (see full feature quote 2 Stardrive, p. 797 *supra*).

Thus a Spinrad trip may involve a sequence of jumps, separated by days of non-movement, the time it takes the Pilot to sufficiently recover from the near-death trauma and be medically

cleared for the next jump. At the end of the story, on the ninth jump, the Pilot died (well, that is not entirely accurate) due to an act of omission by the Captain, leaving the ship stranded Pilotless between stars. The Void Captain's Tale (1982) is the Captain's recorded confession of criminal negligence and fall from social grace.

- Departure: Every ship which begins interstellar movement must have a destination star assigned and travel time calculated before it leaves the origin. From the coordinates of the origin and destination stars, the movement distance is calculated (including Disturbulence Modifiers) and when the movement distance is divided by the departure speed, the travel time, in Regular Turns, is determined (fractions are rounded up).
  - ✓ Ships may not plot destination stars that are beyond the range of the ship's current Operational Flight Limitation (OFL) (see 3 Movement, p. 855, *infra*); Scouts have extended OFL. See Imperial Interstellar Scout Service, 3 Movement, p. 855, *infra*.
  - ✓ When a starship departs the origin system, it is removed from the Public Space (that is removed from the origin star, it is 'removed from the universe') and the destination and travel time are calculated and recorded.
  - ✓ A Power Activation is only required for the departure of the ship – like sending off a paper airplane – additional Power Activations are not required for the continuous progress of the ship toward the destination star.
  - ✓ The ship's progress toward the destination will be updated each time Actions for the position are processed, or, if no Actions are submitted, the ship's progress will be updated at the end of the position's time period for submitting Actions. Ships *en route* to a destination star will not stop traveling because the owning position did not submit Actions! Arrival cannot be avoided by not submitting Regular Turn Actions.
- Space Hop: Short Movement, a 'space hop,' occurs when a starship is able to move between two stars in one Regular Turn. Short Movement is accomplished in less than one Regular Turn if the current Ship Speed is equal to or greater than the movement distance between the origin and destination stars, including any applicable Disturbulence Modifiers (*ut supra*).
  - ✓ Short Movement must overpower all Disturbulence Modifiers in order to be considered short movement. Temporal Disturbulence Modifiers will usually wreck short movement (*ut supra*, p. 847) and sometimes, may make it possible when not possible.

  When a Short Movement is accomplished, the ships arrive at the destination ***at the end*** of the same Regular Turn that they departed the origin and are available for Power Activations and supply functions at the destination at the beginning of the next Regular Turn.

  The turn of departure counts as one turn of movement before the beginning of the next turn. This should be true of all interstellar movements. This is a concession to playability, to make the game move along, and a necessary acknowledgement of uncertainty of how much time is represented by a Regular Turn.
  - ✓ "Get in the fast lane, grandma! The bingo game is ready to roll!" – Mike Lange, Pittsburgh Penguins legendary broadcaster (one of his famous Langisms).
- Heroic Movement: GGDM does not prohibit a ship from moving more than once in a Regular Turn, due to the variable and unknown time periods represented by a turn. This implies that it is possible to plot movement of ships from origin stars at which they are not currently

located; thus, a position could accomplish *heroic* movement by stringing together a number of Short Movements in one Regular Turn through a 'fast lane' of close stars that have Scenes, using multiple Power Activations for the same ship(s). However, the cost is that fast movement may consume most or all of the actions in a turn and a lot of Scenes.

'Leftover movement' upon arrival at each destination star via Short Movement is lost because the ship must pass through the starsystem. Thus, it cannot be added to any continued movement beyond the initial destination star. A movement is complete upon arrival at the destination star, farther movement requires another Power Activation.

- ✓ **CASE:** Endurance rotation is 67, 68 RPM. **Cooper:** CASE, get ready to match our spin with the retro thrusters. **CASE:** It's not possible. **Cooper:** No. It's necessary. – Interstellar (2014).
  - This is the point in the movie when Cooper transcended. You never see how they matched the rotation. It was impossible. The computer was not wrong, empirically speaking. Yet they did. It was necessary.[2]

➢ Long Jump: Long Movement, the 'long jump,' occurs when the moving starship is not able to complete the movement distance in one Regular Turn. No one can physically bar a ship from entering any starsystem, even if it is currently colonized or occupied. Starships engaged in Long Movement arrive *before* the first Power Activation on the Regular Turn of their arrival. Compare this to Short Movement in which ships arrive at the end of the Regular Turn in which they departed. Ships arriving via Long Movement are not in the same system as other ships and colonies at the *beginning* of the Regular Turn for whatever function that might require that as a condition precedent.

"Many men – risking indictment as warlocks or sorcerers – had tried to probe the secrets of the Great Destroyer and compute the speed of these mighty spacecraft of antiquity. Some had even claimed a speed of 100,000 miles per hour for them. But since the starships made the voyage from Earth to the agricultural worlds of Proxima Centauri in slightly less than twenty-eight hours, such calculations would place the nearest starsystem an astounding two million eight hundred thousand miles from Earth – a figure that was as absurd to all Navigators as it was inconceivable to laymen"

– Alfred Coppel, "The Rebel of Valkyr" (1950)

Mushrooms from Alpha Centauri: They must be farming mushrooms as Proxima Centauri is a dim red dwarf star. Proxima Centauri is 4.243 light years from Earth, that is, light from Proxima Centauri requires over 4 years to reach Earth (and over two months to reach Alpha Centauri AB, which is .21 LY away).

- ✓ Light from the sun requires five hours to reach Pluto.
- ✓ At 56,000 km/h, Deep Space 1 probe would take over 81,000 years to reach Proxima Centauri.
- ✓ At 28 hours to reach Proxima Centauri from Earth, the "mighty spacecraft of antiquity" are travelling at 1,327.45 times the speed of light.

2 Movement – Standard Interstellar Movement

This is somewhere around Star Trek Warp 9, according to one table (where Warp 1 = c) in the Memory Alpha article, "Warp Factor" (however, the article clearly demonstrates that the writers have been very inconsistent on Warp speeds, probably from too many 'shrooms on their pizza).

In the Star Trek TNG Season 1 Episode "Where No One Has Gone Before," the Enterprise is thrown 2.7 million light years from our galaxy (allegedly they passed the M33 Galaxy) and Picard states that at maximum warp, the Enterprise would return to Earth in 300 years (there is an amusingly similar scene in Stargate SG-1 season 4 cliffhanger "Exodus" (2001)). That nice round figure equates to maximum warp being 9,000 times the speed of light, that is, the Enterprise would travel 9,000 times the distance of light per year at Warp 9. There is no indication whether the ship gains speed over time, but Warp Drive has always been visually presented as instant, inertia-free, time-dilation free, FTL acceleration and stopping, with constant speed.

What Warp Drive actually is, is whatever 'magic transport' is necessary for each story. See Roger Ebert comments on Star Trek 2009, *ut supra*, p. 848.[3]

"Before Game of Thrones, George R. R. Martin wrote Tuf Voyaging, the darkly comic tale of a solo space traveler zipping from planet to planet with his own unique brand of problem solving. His magic weapon? Mushrooms. As far-fetched as it sounds, fungi are the perfect long-distance travel companion. In the right environment, spores keep indefinitely and are small enough that you could pack an entire farm on a postage stamp. Looking toward to the future and our inevitable trek to the outer reaches of space, mushrooms might just be the ticket we need to get off the planet....

And psychedelic fungi could do more than help pass the time on these long voyages. ...

These substances might even help us stay young or slow the aging process...

The mushroom's ability to cope with space's weird atmosphere, their positive effect on our health and wellness, ease of growth and never-ending appetite make them the ideal candidate to join our race to outer space. Perhaps someday our great grandkids will be sitting on a seat made of mycelium fibers, munching a mushroom 'pepperoni' pizza, hurtling through space on a high-octane fuel of 'shroom juice."

– Ryan Herron, "Spores in Space: These Mushroom Trips Last Light-Years," Dope Magazine, August 11, 2017 [4]

Endnotes.

[1] Commentary: Being on the deep ocean on a safe US Navy transport ship for a time gives only a hint of the vastness of outer space, the mental/emotional impact of a desert of water. Outer space is an order of magnitude more than being on the ocean, the ocean at least has a shore all around it, and air, sunshine, and life. And there is no zapping from one scene to another, instead, we spent days stretched out on and around the sundrenched helo-pad, as we were merely cargo. I remember that I quietly read John Gibbin's In Search of Schrödinger's Cat: Quantum Physics and Reality (1984) on deck, on the voyage to Subic Bay. Whether I *grokked* what I was reading is another matter entirely, but I thought I did then. A couple of days on the waves gives some small appreciation of those who fought in the island-hopping campaign in the Pacific Ocean theatre of WWII, the wonder and the terror.

[2] Citation & Commentary: [In a Soyuz Capsule docked to the disabled Salyut 7 Space Station] **Viktor:** You are a crazy psycho. **Vladimir:** But we docked. **Viktor:** I refuse to continue this mission with you. **Vladimir:** Viktor, do you have a choice? – from Salyut 7 (2017, Russian language with English subtitles).

- ✓ This is not completely analogous to the Cooper situation in Interstellar (2014) because it was not literally impossible, but it was very, very difficult and the people on the ground *had concluded that it was impossible* and the risk of total loss at that speed was too great and were about to call off the mission.

[3] Commentary: This is exactly what drives me bonkers about the internet: A movie like The Conclave (2006) – factual, absorbing and historical – is hardly mentioned or looked at by critics and review sites, while Star Trek 2009 – unfaithful to the franchise whose legacy it bears with characters in name only – is almost universally praised (except by Roger Ebert) for being loud, dumb, and colorful and oh-so-franchise familiar.

- ✓ The same is true of GGDM vs. any regularly overhyped tabletop or video game release.

[4] Commentary: No, I didn't make this up. It's not a misprint or editing mistake. You can find it online. You can stop spacing now.☺

On the serious side, there are a decent number of articles online about experiments with mushrooms in space and it is a topic of interest to science. In "Why fungi adapt so well to life in space" (ScienceLine, March 7, 2018), Matthew Phelan tells the story of astronaut David Wolfe discovering an infestation of fungi behind a panel on the Russian Space Station Mir in 1997. He continues:

- ✓ "Fungi nearly wrecked Mir on multiple occasions. For example, fungus found on one of Mir's Soyuz transports, the variety of spacecraft used to ferry personnel to and from the orbital platform, was once caught eating away at the hardened quartz glass of the vessel's viewports. It etched webs of cracks and corroded the rubber seals connecting the windows to their titanium frames. Mold (a variety of fungus) became so widespread that cosmonauts and their international colleagues would return to Mir to discover that the whole place smelled like a basement full of rotten apples, as noted in the January 2016 issue of the Russian edition of Popular Mechanics." *Id*.

Tristen Wang in the Harvard Science Review article, "Astromycology: The 'Fungal' Frontier" (June 2, 2015):

- ✓ "The discipline of astrobiology attempts to answer the larger mysteries about life: its origin, necessities for survival, and presence in other worlds. But astrobiology also has practical applications in considering how biological organisms may travel through space. In particular, human space travel would greatly benefit from studying a branch of fungal biology known as astromycology: the study of earth-derived fungi in space. Fungi offer both an opportunity and threat to human space travel. Problems arising from fungal intruders are both wide and relevant, ranging from providing food and decomposing biological material to breaking down spacecrafts. Interactions of intense radiation and lack of gravity with fungal growth underlie the opportunities and threats that fungi pose to human space travel." *Id*.