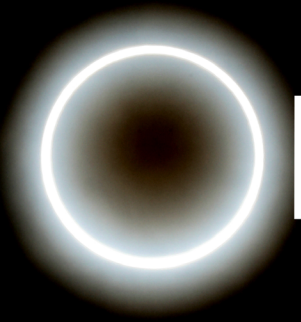
# RINGS  F FIRE

## how the brain makes CONSCIOUSNESS

*'takes a very QRI-esque phenomenology first approach'*
*—Qualia Research Institute blog*

*Presented upon at the 2023 Science of Consciousness conference in Taormina, Italy, this book explores what Carl Sagan called 'outlines of...instant appreciation,' taking inspiration from Steven Lehar as well as from Global Workspace Theory.*

**BRAD CALDWELL**

# RINGS OF FIRE

## how the brain makes CONSCIOUSNESS

*Brad Caldwell*

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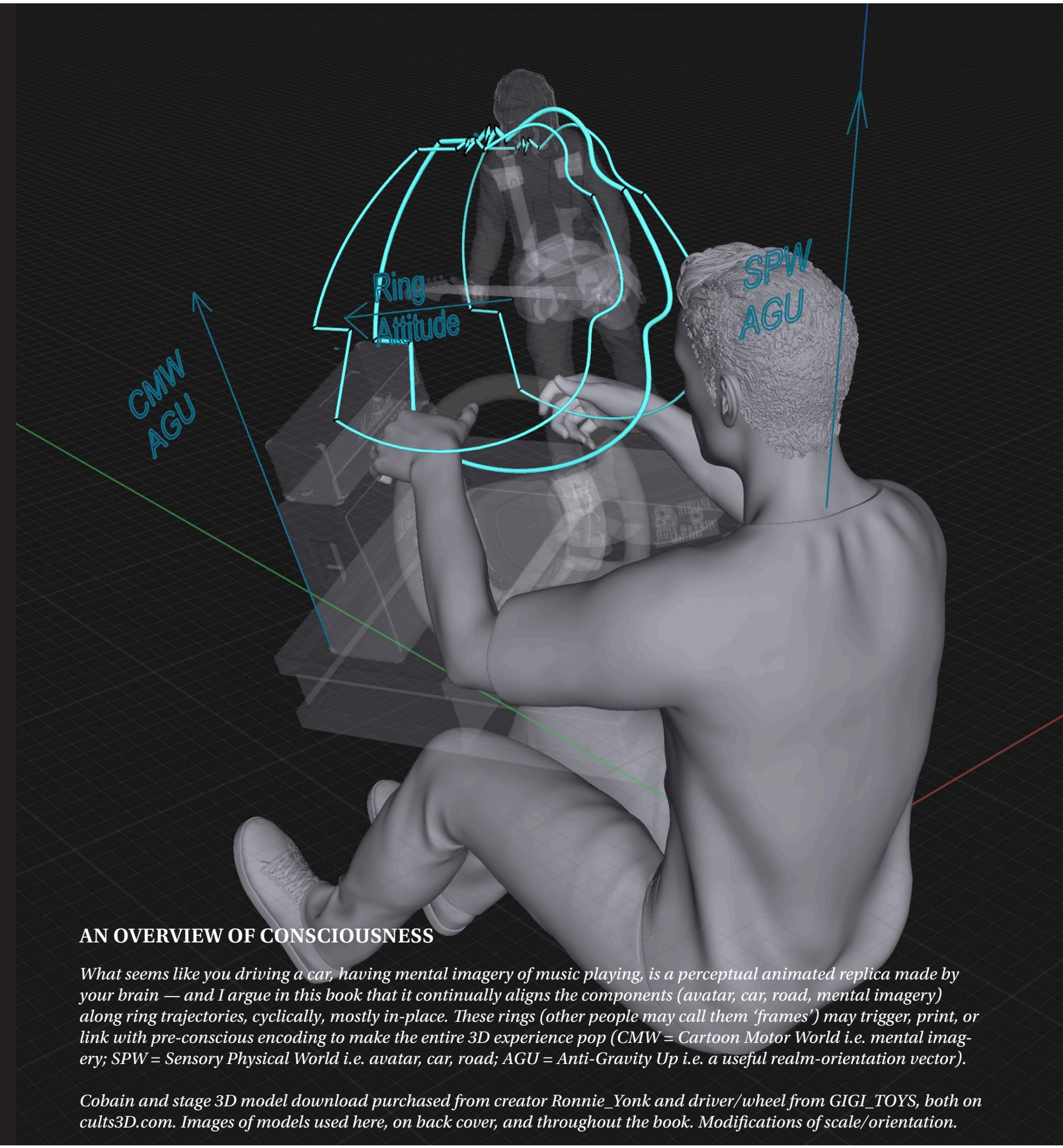
# RINGS OF FIRE




## AN OVERVIEW OF CONSCIOUSNESS

*What seems like you driving a car, having mental imagery of music playing, is a perceptual animated replica made by your brain — and I argue in this book that it continually aligns the components (avatar, car, road, mental imagery) along ring trajectories, cyclically, mostly in-place. These rings (other people may call them 'frames') may trigger, print, or link with pre-conscious encoding to make the entire 3D experience pop (CMW = Cartoon Motor World i.e. mental imagery; SPW = Sensory Physical World i.e. avatar, car, road; AGU = Anti-Gravity Up i.e. a useful realm-orientation vector).*

*Cobain and stage 3D model download purchased from creator Ronnie_Yonk and driver/wheel from GIGI_TOYS, both on cults3D.com. Images of models used here, on back cover, and throughout the book. Modifications of scale/orientation.*

# CONTENTS

# The Conscious Cycle

## 1. Tracer/ 3D Cursor

"Let's make some consciousness!"

## 2. Bank

"Use this 3D Etch-a-Sketch to inform and record your ring/frame paths, tracer."

## 3. Flow

"I'll blow 'that printed' away so it doesn't get in the way, making a one-second flowing time window. This way, sequences of items can be attended."

## 4. Throw

"I'll blow 'that printing' so as to convey surprise forces like inertial throw of making a turn while driving or going over a large bump."

## 5. Vibes

"I'll do frequency, radial-amplitude, and other modulation tricks on the rings to convey sounds (and scents, cold, mood, pain, etc.)."

## 6. Perspective/ Viewer/Content

"I'll help read the situation and flesh out objects, avatar, visual field."

## 7. Response

"Let's respond to the situation."

# 1

## *Ring Behavior*

*Huh huh, uh... Huh huh, uh... Woah! I think I just figured something out, Beavis!*
*— Butthead, Mike Judge's Beavis and Butthead Do America*

THE THEORY I'm about to present is entirely novel. Chapter six will be entirely devoted to how I stumbled upon these 'rings' in my quest for answers about consciousness. The subject of consciousness has always captivated me—how does the brain create phenomena like sound and color, which seemingly don't exist in the physical universe except as frequencies? How does it conjure sensations of cold and heat, scents, mental imagery, anticipation, and caution? How can all of these experiences be distilled into a single unsatisfying explanation like 'action potentials,' which are not all that different from basic electricity? It simply didn't add up.

Then, on January 1st, 2022, in a deeply 'NMDA-antagonized' state[1], I had my breakthrough. I realized that our entire experience is a simulation generated by the brain, for the brain—albeit modeling the not-directly-observable reality. This revelation explains how the brain can convey a myriad of qualia with a single trick—***movement of a 'brush'***! You can paint anything, and probably even perceptual color, just by how you move the brush over time, and what content you say it is linked to. But the "brush" usually paints this video with ***ring*** trajectories (*likely with help* from other encoding mechanisms). It's akin to how old TVs printed the screen via lines—but consciousness is 3D (volumetric). Anyway, I witnessed thousands of rings that night, ranging from 2 to 14 Hz (later in the night, they resembled large 'puzzle pieces' stacked on top of each other, pushing the older ones aside). I was utterly astounded! To this day, I remain fascinated by rings, as they challenge me to uncover their neural mechanisms.

1 The NMDA-antagonized state is induced by sleep-deprivation; pre-stroke aura; or by exogenous ligands like alcohol, ketamine, or hemp's THC. The GABA-agonized state may be similar, induced by barbiturates, or via muscimol in fly agaric mushrooms (beware their toxic ibotenic acid). *Strobing* is widely-reported in either state (2-20+ Hz), the outlines of which are the 'rings' discussed in this book. Occasionally, *dissociation* may also occur, where transient loss of conscious sensation/control of the 'avatar' occurs. Some exogenous ligands have legality/safety issues.

**Incipient Consciousness Order — Time Flow Awareness, Location Awareness, Content/ Perspective Awareness, Response**

Much of what the brain does operates beneath our conscious awareness. However, when it comes to the elements dedicated to consciousness, the brain usually begins with a tiny paintbrush 'cursor.' Unlike a computer cursor, this fiery **'tracer'** moves freely in three dimensions, identifying bits of information as it goes along ('Such and such voxel within your right elbow! Such and such voxel within the air in front of you!'). It traces a 'ring' as it moves through space. The brain's origins (both your own brain's origin when you were developing, and earlier lifeforms' brains) as a tube of neurons might explain why consciousness adopted rings to navigate its modeling space, akin to a game of 'hot potato'—orchestrating cells around a single narrative. But perhaps even lifeforms as simple as slime mold use rings. If so, one possible mechanism would be the use of time to cyclically iterate over locations in a modeling space so as to track direction to food (using bio-electrical signals to unify into a single 'self').

These rings, which I'm discussing, do not always adhere to the boundaries of objects or solid surfaces in the 'real world schema.' They can pass through physical objects and the air. But, occasionally, they purposefully align with text, faces, lips, or object boundaries.

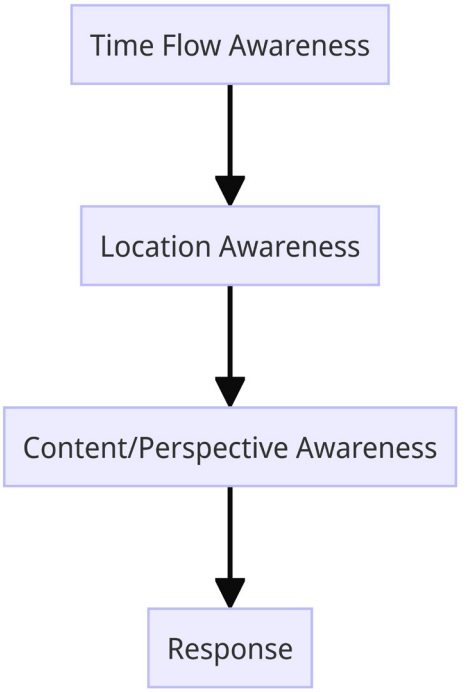
Rings serve as a fundamental brain unifier, aligning the avatar with the car she's driving and the road and her mental imagery—all of which can be in constant motion relative to one another. Could the alignment process have been anything other than rings/frames at the sub-second scale? The brain is powerful, but there's no need for the alignment of every one of the billion-plus voxel points of avatar, car, road, and mental imagery to be computed each tiny moment—this would not serve the organism's survival! Just compute alignment of one voxel point each millisecond; with ring trajectories—and occasional topological, surfacial alignments—on the decisecond (100 ms) or centisecond (10 ms) scale.

There is also an intriguing aspect of spatial proximity that triggers the unveiling of objects and understanding of the entire 3D scene. It reminds me of the waving of the tip of a Disney magic wand, with proximal sparkle expanding from where the tip traced—or like the growing wake left by a motor boat. If I know that the tracer's current position is a specific voxel in my right elbow, and I have some other body info coming in, the former information can enable the helper information to flesh out the full 3D body. When information is abundant, we can't even notice the rings; however, when information becomes scarce, as in states of NMDA-antagonism, the 3D understanding can 'fall through the cracks' at moments, and we see the mysterious, underlying rings working their magic.

At this point, it's crucial to emphasize that the material of the rings consists solely of location information. It can be described as 'fiery,' 'icy,' 'invisible,' 'amodal,' 'point cloud,' or 'translucent skin.' It is location awareness devoid of content. However, it is also isomorphic location awareness, which means it is perspective-independent and doesn't require a 'viewer.' This is similar to understanding a model without specifying your location as a viewer. While a Necker cube can confuse front and back, the cube 'bank' responsible for these ring paths remains unconfused, as it is fundamental model, and exists prior to perspective.

So, ring material consists of location awareness prior to content; but, the content is added right away ("So and so voxel within your right elbow!"). There is probably one thing even prior to this location awareness: time flow awareness. Under sufficient anesthesia, even consciousness' last stand of *time flow awareness* ceases.

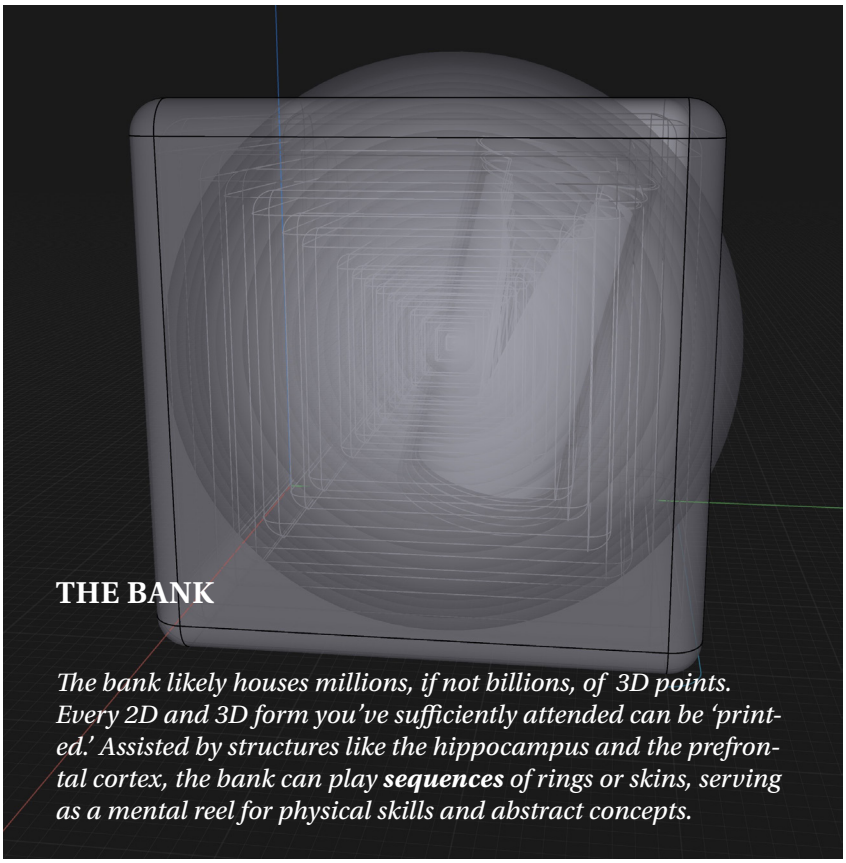
Moving on, there's another case of 'spatial proximity' triggering, but this time it occurs on the 'bank' (which we'll discuss shortly). This amodal location-only information can connect with neighboring voxel points, transforming a 1D ring into a 2D surface. The resulting sheet can take the form of a circle (the inner area of the ring) or a wristband (with axial growth perpendicular to the ring). This flexibility allows location information to take on the topology of objects we encounter, such as the face of a friend we are observing. Throughout this book, I often use the term 'ring' broadly to refer to any such frames of consciousness.




I want to introduce you now to my favorite 'character of consciousness'—the **'bank.'** Bank is perhaps a funny name, but so are 'Isometry Transceiver,' 'Model Store,' 'Shape Memory,' and '3D Etch-a-Sketch.' Perhaps Alan Baddeley sounded the most scientific when he called it the 'Visuo-Spatial Sketchpad.'[2] The bank is the set of rules which ensure that rings link multiple schema objects (avatar, car, road, mental imagery) in a way that

2 Baddeley, A. & Hitch, G. (2011). Exploring working memory: Selected works of Alan Baddeley. Oxford University Press.

*honors 3D accuracy* and that has access to handles to all your *memories* (to understand meaning). It's as if the bank is a '3D loom' serving as a hard template to guide drawing. The bank knows 3D.



**THE BANK**

*The bank likely houses millions, if not billions, of 3D points. Every 2D and 3D form you've sufficiently attended can be 'printed.' Assisted by structures like the hippocampus and the prefrontal cortex, the bank can play **sequences** of rings or skins, serving as a mental reel for physical skills and abstract concepts.*

So yes, I genuinely mean that an invisible cubic scaffolding, complete with mappable voxel points, scurries through your experience like a spider at lightning speed. It even rotates and scales as needed to facilitate the ever-shifting focus of your attention. And I'm not primarily referring to saccades here; rather, I'm highlighting how your attention can 'walk' from this book to the sensation of your back against the chair, and then to mental imagery—all within a single second. However, the snapshots revealed from the 'bank' by momentary 'flashes,' potentially of Local Field Potential maxima, are eerily motionless. While the bank is in constant motion, what you capture are these perfect stills, as if frozen by a strobe light.

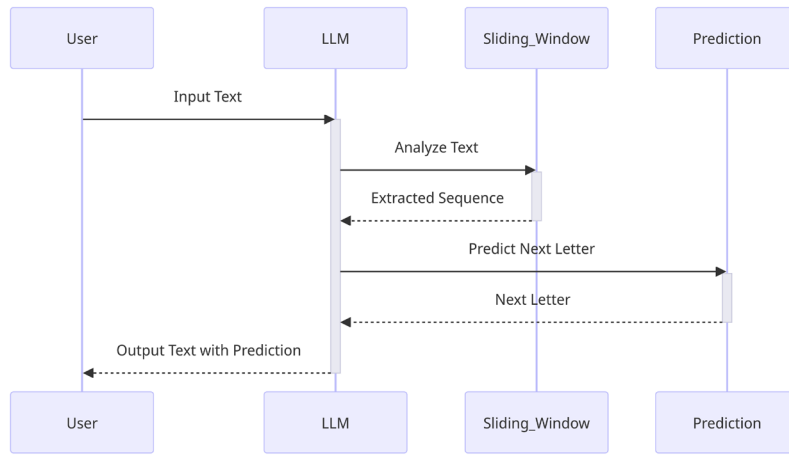
So when I referred to **'throw'** in the introductory figure ('The Conscious Cycle'), here's how it operates. Imagine you're a passenger in a car, and your friend takes a sharp left turn. You feel a force pushing you to the right. What you're experiencing isn't the actual physical force in the universe (which isn't directly observable and wouldn't be felt if you were unconscious). Even this sensation of being 'thrown' has to be 'rendered' by the brain. My hypothesis is that the 'bank' is usually moving autonomously, but it can be abruptly diverted from its course. It will render the voxels at this new location, but the sensation of force arises from the bank/rings being thrown off their original trajectory.

If I may be so bold, all felt qualia get their feeling from some sort of tweaking of location awareness (bank/ring). Sound feels like a vibration in our simulation—I propose it is a vibration of the rings or a frequency modulation of their print rate. But even scents, surprising temperatures like cold water, your mood, and the instability of fear may be printed in a similar way, by these **'vibes.'**

In the table of contents, the figure titled 'An Overview of Consciousness' introduces the notion that your experience—say, of sitting in a car—is primarily rendered as a series of rings iterating mostly in place. Contrary to what you might think, your brain isn't fixated on every voxel of your avatar. It starts rendering at a certain point in the simulation and continues, providing just enough information for the full 3D experience to 'pop' into awareness (with help from other encoding mechanisms). This is crucial because it underpins the 'flow' process I discussed in 'The Conscious Cycle' figure.

Let's delve into **'flow.'** Generally, as the brain triggers consciousness by this tracer following ring paths (typically 7-40+ per second), the 'ink' it leaves behind—representing the content linked at each point—gets axially 'blown' away to make room for the next ring cycle. This mechanism allows for a 'tunnel' of experience, featuring +0.5-second future predictions at one end, the present in the middle, and -0.5-second past working memory at the other end. In essence, you're always perceiving a one-second window of ongoing events. As time progresses in the physical realm, the brain keeps updating—what you see is always sliding from future into past, making you feel like you are constantly moving into the future. This is actually important for felt qualia—the sense of vibration or modulation of rings as you are moving into the future is what gives qualia their feel.

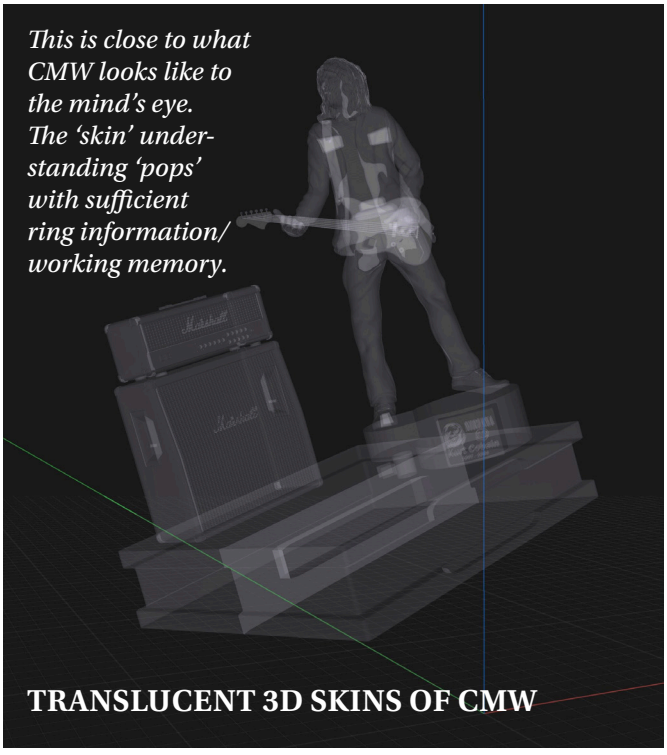
Interestingly, the CA1 region of the hippocampus is posited as a site for a unique neural mechanism called Behavioral Timescale Plasticity (BTSP).[3] Unlike conventional neural plasticity, which functions on brief 10-20 millisecond timescales, BTSP enables the hippocampus to associate a full second's worth of sequence-related episodic memory items. This is a capability that the cortex generally lacks without extended support from the hippocampus. The mechanism is akin to how Large Language Models analyze a sequence of letters within a sliding window, using observed changes to inform text prediction.



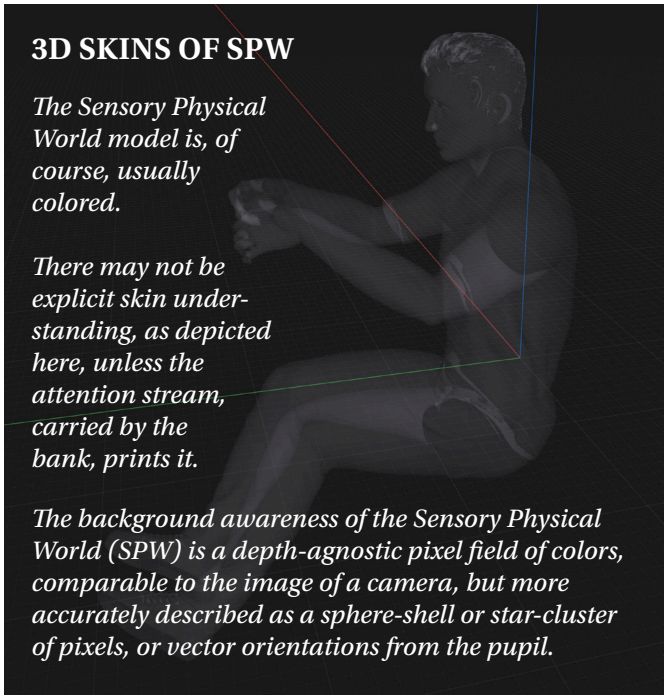

3 Cone, I., & Shouval, H. Z. (2021, February 8). Behavioral time scale plasticity of place fields: Mathematical Analysis. Frontiers. https://www.frontiersin.org/articles/10.3389/fncom.2021.640235/full.

In humans, each of these 'windows' undergoes slight potentiation, becoming part of our episodic memory and contributing to our life story. Over the years, we amass millions of these sequence snippets that can guide our actions. Meanwhile, 'muscle memory'—stored in neural regions like the basal ganglia and cerebellum—serves as a subconscious repository for primarily motor aspects of these sequences.

In my initial version of this book, I coined the terms 'Cartoon Motor World' (CMW) for internal imagery and 'Sensory Physical World' (SPW) for external imagery. Interestingly, Carl Sagan also delved into the realm of consciousness, particularly in states influenced by NMDA antagonists.




He didn't dismiss these experiences as mere aberrations; instead, he saw them as windows into the mechanisms of consciousness. Sagan even observed these 'rings,' though he referred to them as 'outlines of...instant appreciation.' He associated them with a cartoon-like realm, rather than extending the concept—beyond internal imagination imagery—to the external 'real world schema,' as I do (see block-quote, facing page[4]).




I'd like to emphasize that these rings typically serve as one-dimensional outlines. The **'content'**—whether it's your external visual field or mental imagery—often becomes fully realized through built-up buffer (working memory), likely aided by other encoding techniques. However, if you need detailed, 2D point-cloud style attention on any subject, the bank can certainly accomplish it.

4 Sagan, C. (1969). Mr. X. The Library. https://www.organism.earth/library/document/mr-x.

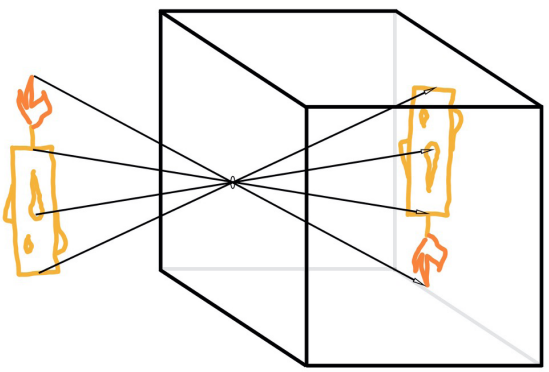
**"Another interesting information-theoretical aspect is the prevalence—at least in my flashed images—of cartoons: just the outlines of figures, caricatures, not photographs. I think this is simply a matter of information compression; it would be impossible to grasp the total content of an image with the information content of an ordinary photograph, say 108 bits, in the fraction of a second which a flash occupies. And the flash experience is designed, if I may use that word, for instant appreciation. The artist and viewer are one."—Carl Sagan**

It's crucial to grasp two fundamental geometric aspects of consciousness: model and perspective. A model is faithful to spatial relations, whereas perspective focuses on how that model impinges upon a specific viewpoint. When combined, you gain a hybrid ability—the far end of a hall seems smaller ***and*** equal-width to the close end, depending on the vantage of perspective or model.

Each pixel is a unique vector orientation from the pinhole outwards (and contains color and intensity information). When you use a pinhole camera, the entire image exists at the pinhole just as well as at the sensor of the camera where it gets recorded. As the viewpoint is moved, all that changes are the vector orientations (and light rays sampled). And the changes in orientations follow complicated, but calculable, rules.

A perspective image literally exists at every voxel point in the physical universe. Perspective, in this case, is simply how light from stars and planets impinges on that point. If you had a pinhole camera, you could capture half of the sphere surrounding any 'viewpiont.'

The universe, unlike a pinhole camera, is like a model—faithful to maintain 3D spatial relations. In this way, the universe is like the brain's spatial models which can exist without a viewer. The model is first in consciousness—the avatar with her cyclopean 'viewer' pupil is added last.



Once the brain establishes both background awareness and specific attention—collectively termed 'content'—it can then generate a conscious **'response'** that's informed by this content. Importantly, this response operates on its own parallel thread, largely decoupled from incoming data.

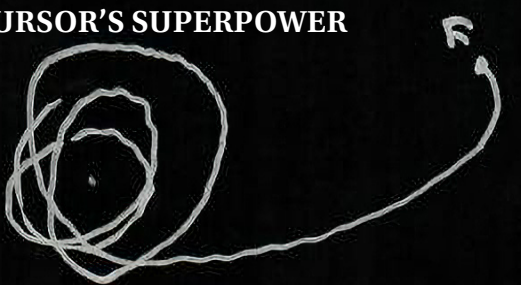
**3D CURSOR/TRACER**


*Without specific path constraints, the tracer would seemingly act like an electron in an orbital.*

**SONIC THE HEDGEHOG 'BLUE WHIRL'**

*Another example of how the 3D cursor might move in the absense of rules.*

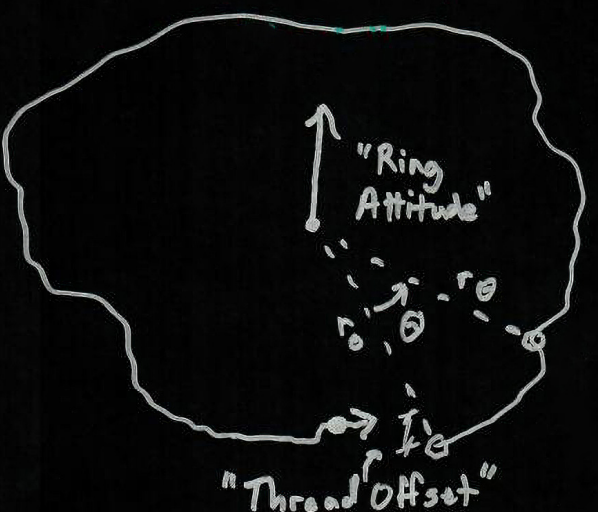
**3D CURSOR'S SUPERPOWER**

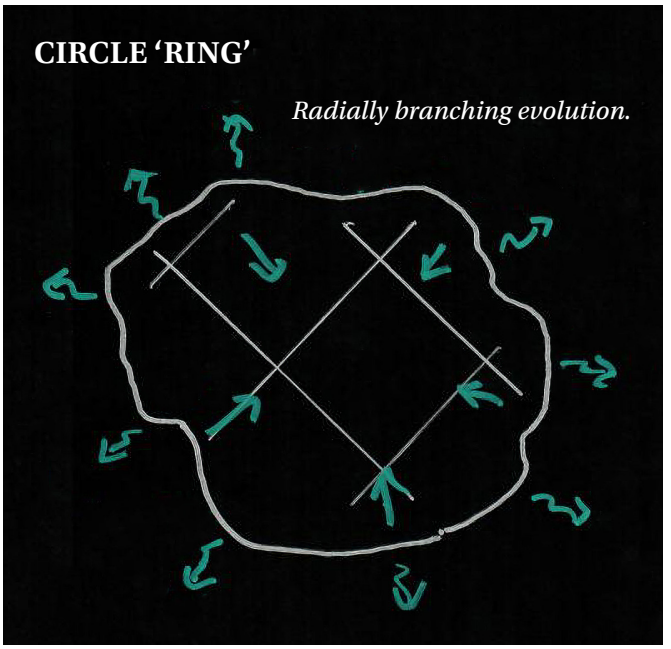


*The 3D cursor can quickly expand/shrink its radius to get to any focal point in CMW or SPW.*

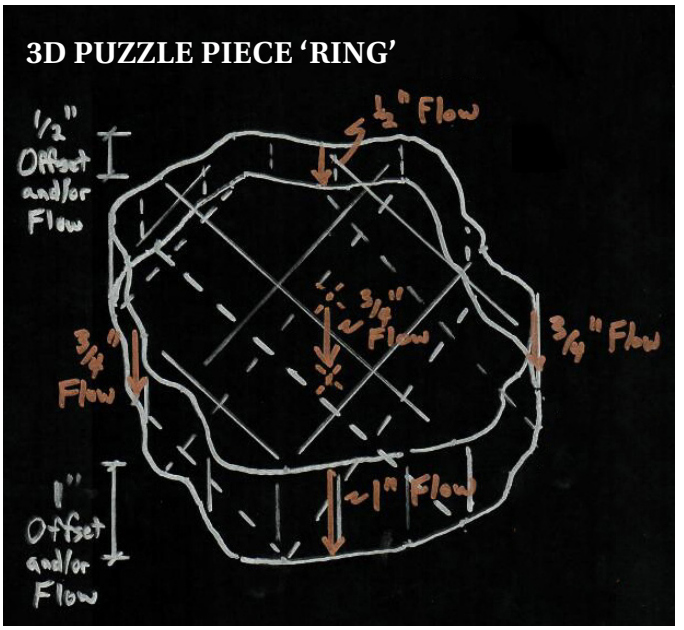
So there you have it: a preliminary outline of my understanding of how consciousness functions, from the point tracer all the way to the behavioral response. The accompanying figures should help clarify these concepts. Keep in mind that ring material is fundamentally about location-awareness, and that a set or sequence of these locations can either form a point-cloud model or a ring trajectory. The behavior of these rings is governed by a complex set of rules and exceptions, which I'll unpack gradually throughout this book.

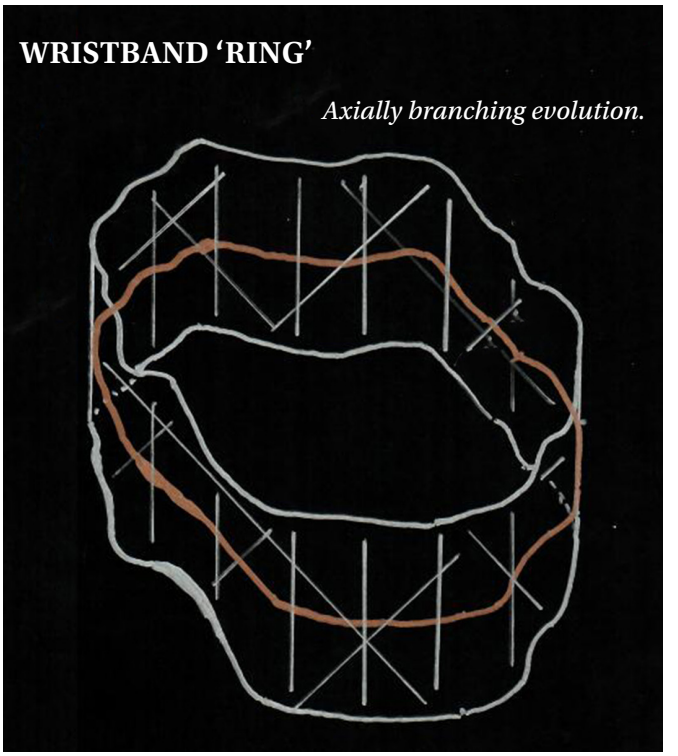
**THE RING: TRACER FOLLOWING A BANK-SPECIFIED PATH**



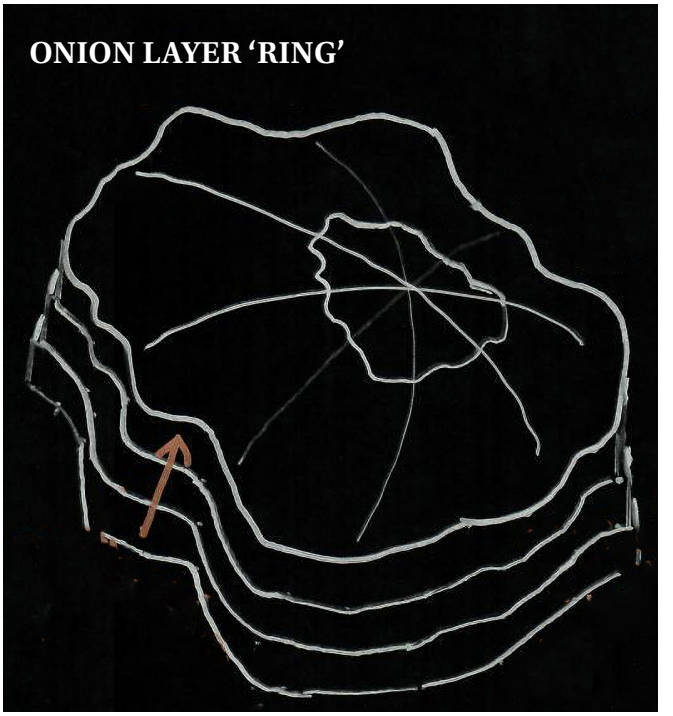



Don't get hung up on these sketches—they are just depictions of some of the shapes that location-awareness may take as the brain crawls over the 3D space in which consciousness is depicted, 'refreshing' the content. The bank is like an engine, and it churns through its own store of shaped screens for the 'perception dashboard' by which the brain can then consciously influence the body.

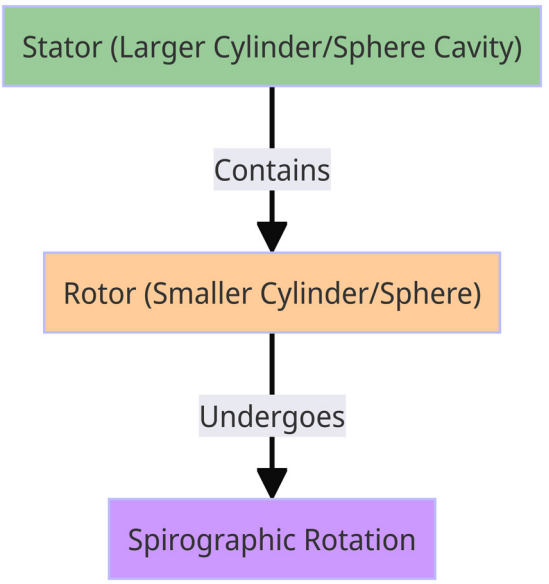



If you're asking 'which body?', you're on track. The body you're familiar with is your perceptual body. But conscious control influences both perceptual (avatar) and physical (real) body.

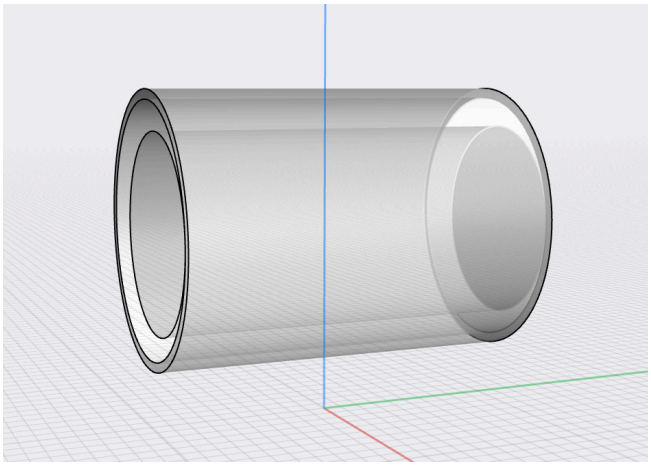


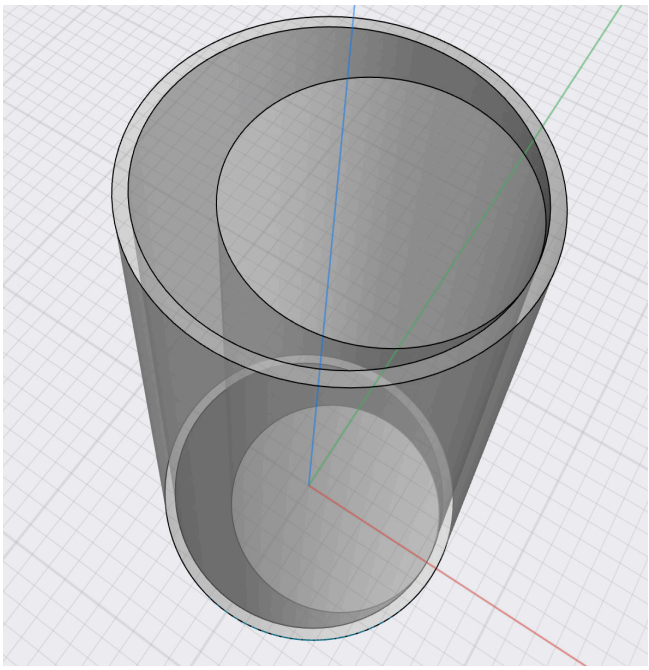
Let's consider a few more of these shapes before we move on. Remember that we are in the geometric realm of *model*, where distance relations between points are maintained (fidelity to Cartesian space). So, it's fairly common for the brain to employ 'Spirographic' movements

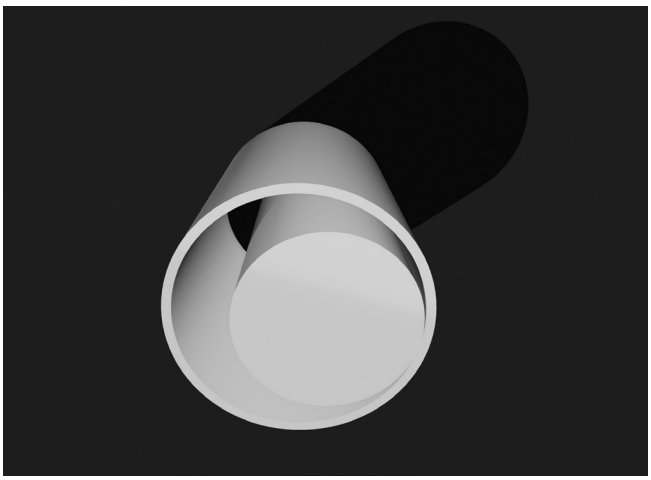


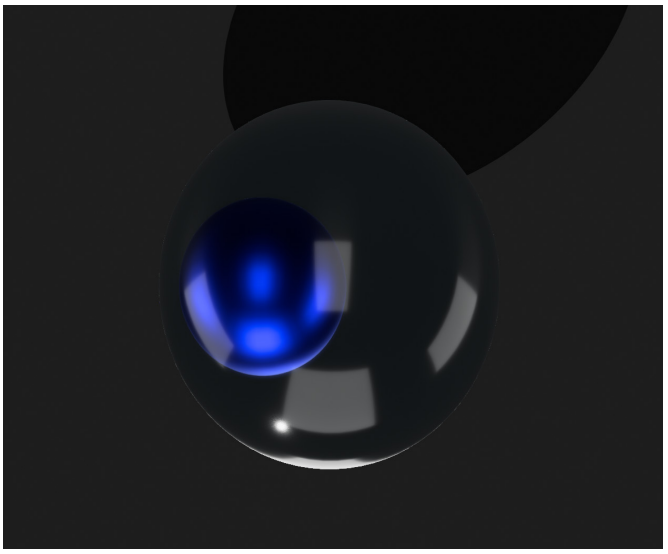

through perceptual space as it refreshes content, whether the rotor/stator are cylindrical (axis vertical, horizontal, front-back relative to your body, or any off-kilter axis) or spherical. Imagine the following cylinders in front of you, larger-than-life, refreshing your experience's content as the rotor moves about the stator cavity.

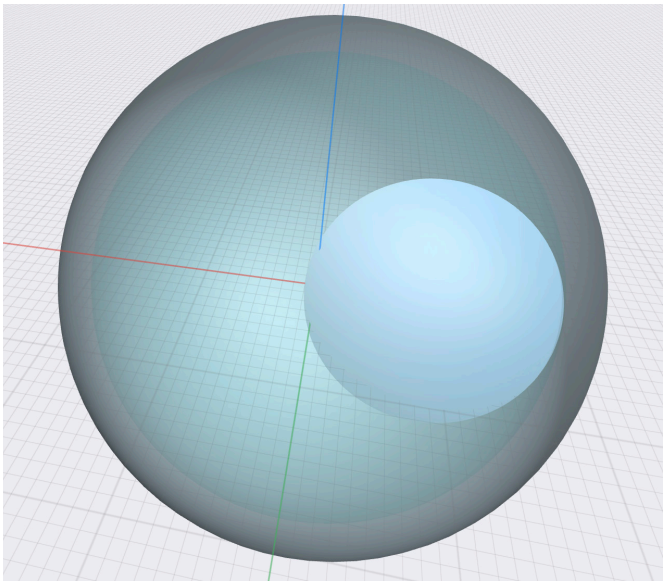
Imagine cylinders oriented along the axes normal to three anatomical planes: the sagittal, horizontal, and coronal. Now, picture a spherical rotor gracefully tracing a Spirograph-like path within a larger spherical cavity. These geometric











constructs, originating from what I call the 'bank,' serve as the framework for our perception.

For Spirographs (which such rotor and stators are), k = R/r, where R is the radius of the hollowed cavity (radius of inner surface of stator), and r is the radius of the inner rotor. The inner rotor always makes k – 1 rotations per revolution. The patterns traced by a pencil on some point on the circumference of the inner rotor are called hypocycloids. If a pencil were inserted in the rotor somewhere between the rotor's center and its circumference, it would trace a hypotrochoid (a Spirograph); dead in the center, it would merely trace a perfect circle. When the brain is using this mechanism, the outer shell of any of these 'Spirograph' rotors gets sloughed off radially outward (or inward) over each revolution and fades out of working memory.

The bank's size (measured by real world schema distances as it overlays) changes with the focus of your attention. When you're engrossed in your phone, the bank might occupy an 'external world' size of about a cubic foot. But shift your gaze to the vastness of the Grand Canyon, and the bank now overlays thousands of cubic feet of canyon.

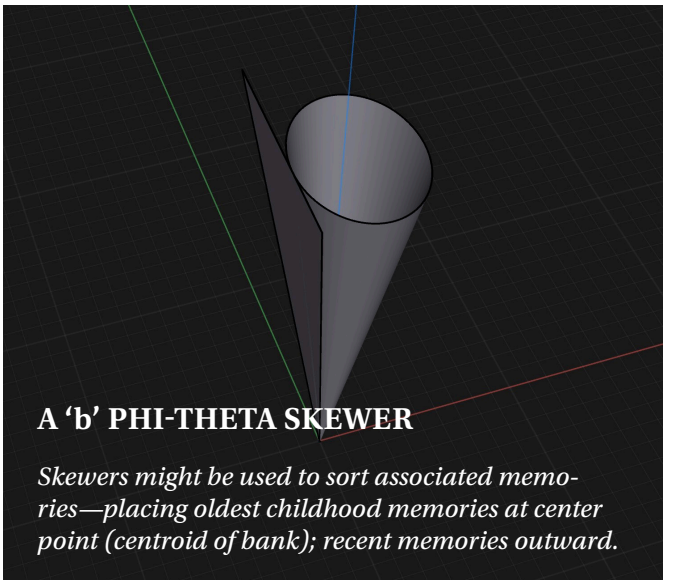
It's also fairly common to attend to the shape of some object, like a face, a scene, a bicycle, or a letter. But, nuance is key! There's two types of identification: *perspectival*—such as the distance between eyes/mouth (and the orientations), and *topological*—such as the surfacial topology of a face. This is illustrated in the face image—the topology of the face is in light grey, and the perspective phi angle between the eyes ('feature extraction') is indicated in dark grey *flipped* light rays.

And alas, that is a funny thing too. The light rays actually come from the model's face to your pupil, but the brain seems to start with the face/object,

**TOPOLOGY VS. PERSPECTIVE**

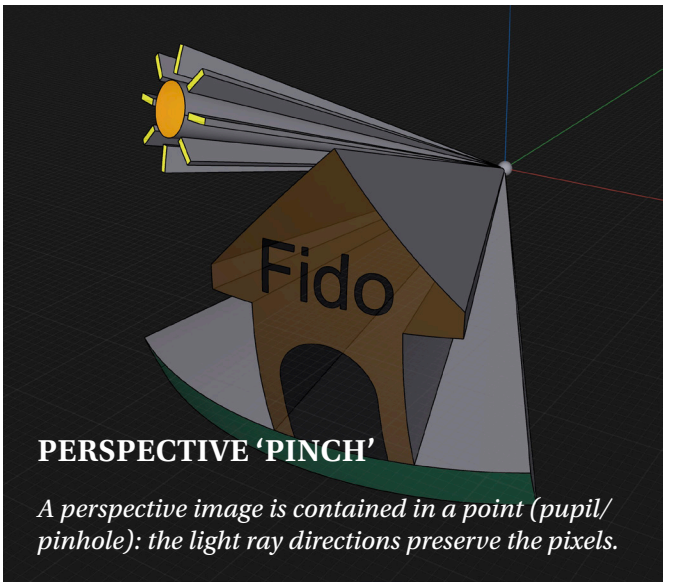
*One can attend to the topology of this face (light grey), but one can also extract perspective features such as the phi angle between the eyes (dark grey 'rays of light' and phi angle). It may be tricky to envision the distance between eyes as a phi angle, but it is best to do so.*

and go backwards to a vanishing point. This way, it can let phi-theta patterns get associated with, and packaged up with, their source in the world—it gains the ability to feature-extract invariant of scale, 3D-orientation, or location of the object relative to you. What started out sounding weird in personal observation (phenomenology) gains utility with geometrical observation—'phi-theta skewers' are viewpoint invariant (but, so are flat features, if similarly allowed to rotate/scale/move in 3D modeling space). As shown, ***image features can be defined by sets/relations of directionalities.***



**A 'b' PHI-THETA SKEWER**

*Skewers might be used to sort associated memories—placing oldest childhood memories at center point (centroid of bank); recent memories outward.*




**PERSPECTIVE 'PINCH'**

*A perspective image is contained in a point (pupil/pinhole): the light ray directions preserve the pixels.*

In the process of identification (which seems to be largely *perspectival*), the brain appears to 'delegate'—it segregates the workload, giving *categories* of identity-extraction to various regions of cortex. For example, a partial lesion of the parahippocampal place area (PPA) and/or retrosplenial cortex (RSC) may destroy your ability to have mental imagery of large scenes[5] (you won't be able to draw a blueprint of your house because you can't imagine the rooms and layout anymore). Damage to the fusiform face area (FFA) can leave you, like the case Oliver Sacks wrote about[6], unable to extract face-identifying patterns. The Visual Word Form Area (VWFA)[7], right next door to the FFA, is needful for extracting letter and word patterns invariant of location/size/orientation in the visual field.[8] I want you to think of the letter 'b' not as a flat pixel pattern (which is okay in 3D modeling space), but as geometry requires perspective to consider it—a *phi-theta skewer.* These examples (especially the latter two), may be *prior* to the formation of a modeling surface (such as the topology of a face or a raised-relief topological map of your environs), and may rely on what I call 'phi angle + theta orientation patterns.' Or, just call it shape created from recruitment of specific 3D direction vectors,

5 YouTube. (2018). Nancy Tells a Story to Introduce the Course. YouTube. Retrieved November 3, 2023, from https://www.youtube.com/watch?v=i1pdQjdAndc.

6 Sacks, O. (1985). The Man Who Mistook His Wife for a Hat: And Other Clinical Tales. Summit Books.

7 YouTube. (2018). Educating the Brain - Stanislas Dehaene. YouTube. Retrieved October 31, 2023, from https://www.youtube.com/watch?v=0esnsHI4opA.

8 Interestingly, artificial direct stimulation (by implanted electrodes) of FFA leads to hallucinating the identification of a face in any readily available imagery like a soccer ball hexagon or a Chinese letter, but not so much if there's nothing in the center of the visual field to latch on to. Related: Azadi, R., Bohn, S., Lopez, E., Lafer-Sousa, R., Wang, K., Eldridge, M. A. G., & Afraz, A. (2023). Image-dependence of the detectability of optogenetic stimulation in macaque inferotemporal cortex. Current Biology, 33(3). https://doi.org/10.1016/j.cub.2022.12.021.

outward from a 'pinch point.' In other words, 'b' can exist on a flat plane, with parallel rays going backward into the page. But you can 'pinch' the rays into a point at any distance behind the page to create a skewer—pinch it just below the letter and you create a 'wide angle skewer;' or pinch it further back and you get a 'narrow angle skewer.'

If you could make a camera with tiny straws leading to each pixel of the sensor (and no lens), you could capture only b's *parallel* rays without any pinch (get an orthographic image). But human eyes and most cameras sample from a point—the pupil, the pinhole—which by definition throws away the parallel rays, leaving you with rays converging to a point. Each part of the 'b' casts light rays outwards in every 3D direction—there isn't any literal pinching going on—rather, it is which rays you attend to: parallel, get an orthogonal image; coming to a point, you get a perspective image (with wide/narrow angle field of view influenced by your distance away from the object). Theoretically, the brain could work with 'b' on a flat plane, but my feeling is that it extracts it from the visual field in its original perspective form.

As another example, you can 'see a face' in an electrical outlet—a phenomenon known as 'pareidolia.' The brain seems to be looking for distance between 'eyes,' and a relative distance downward and centered for a 'mouth.' But since the retina does not capture an orthographic image—but rather a perspective image—the distance between pixels is most precisely described by the ***phi*** angle subtended between any two pixel vectors ('rays of light') and the orientation between them (vertical, horizontal, mix: denoted by ***theta***)—or just by the collective '3D direction vectors' from viewpoint outwards and relative relations, if you have a way to specify/map to each vector.

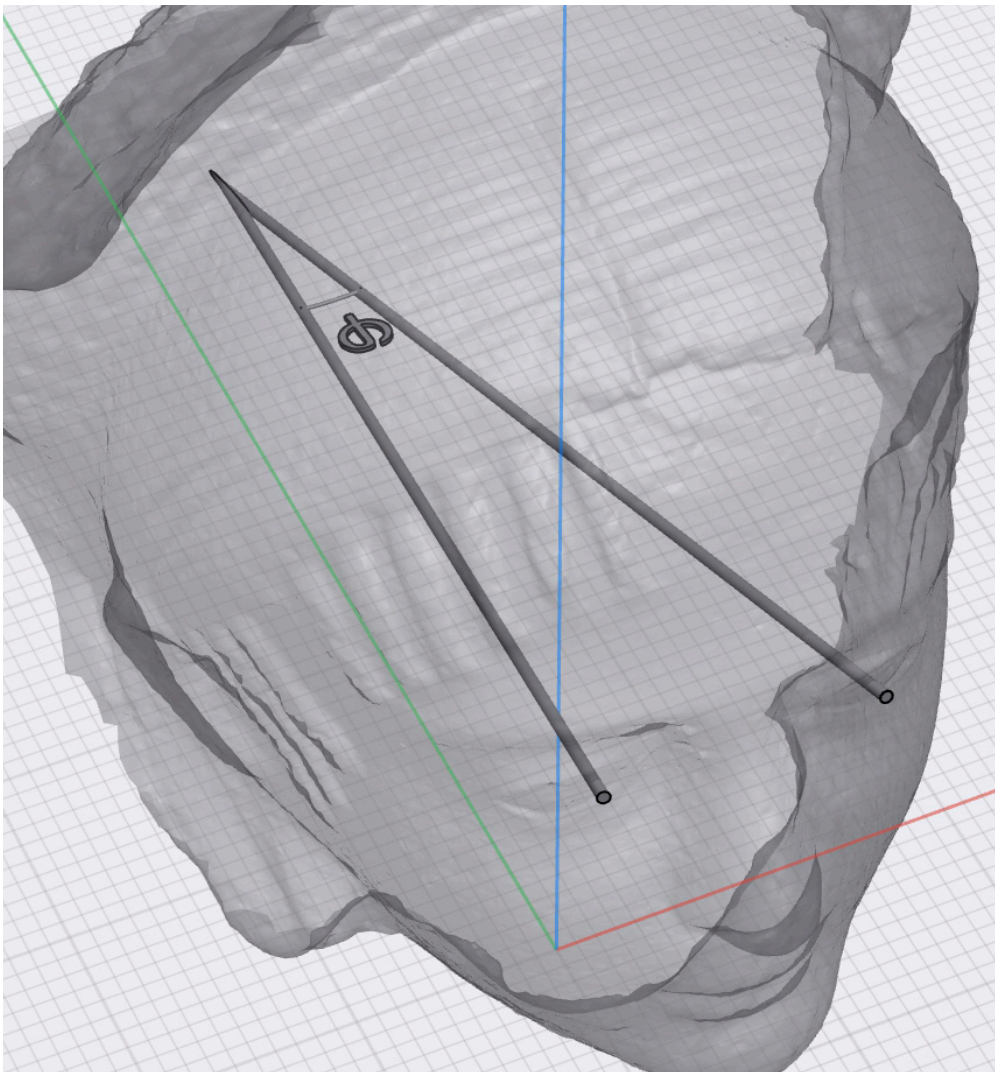
Imagine you're inside a sphere, wielding a laser that's pinned at the sphere's center but free to move along its surface. As you manipulate the laser, you carve out skewer-like patterns. This concept aligns with how light-field cameras work; they reconstruct 3D models by treating each pixel as a directional ray of light and calculating its radial depth from the lens. Given this, it's logical to 'hang' detected object skewers onto a sphere of the bank. In this context, your eye's pupil serves as the 'pinhole,' the singular point where the entire image converges and from which you sample the scene—be it within perception or actual reality. All of this is guided by principles of geometry.

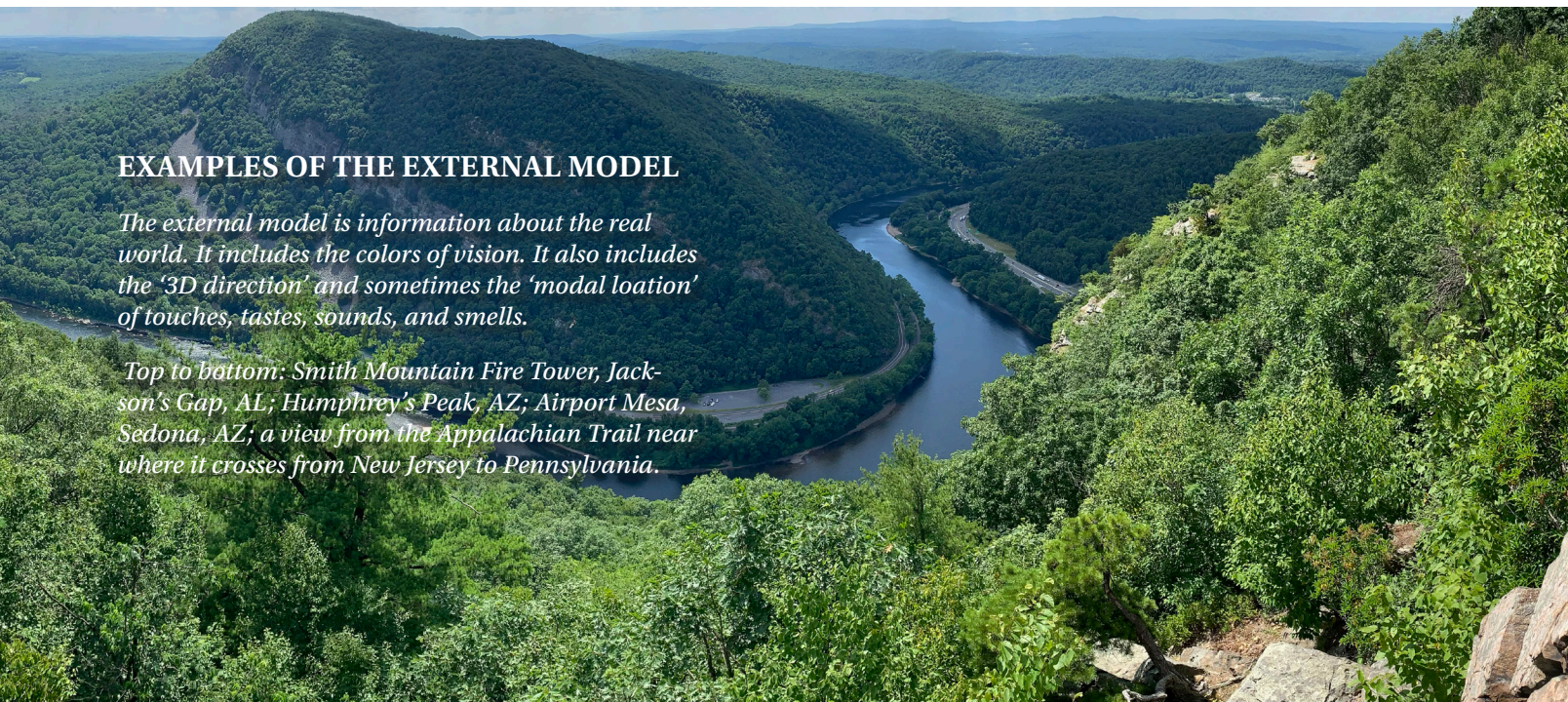
If you're feeling overwhelmed, let me reassure you. At its core, the 3D perceptual display consists of the 'bank printhead'—think of a cubic volume where each point can emit ink—and the fading, flowing ink it prints. The complexities of identification and response are largely managed by what could be termed 'magic,' which is really conscious thought and agency working through

subconscious processes. In the display, there's 'that printing' and 'that printed'—too easy!

When you marry the visual field's perspective 'star cluster' of vectors (from cyclopean pupil outwards) with a moment of attention printing a 3D 'translucent skin' model of the scene, you get the most accurate understanding of the environment possible to perception/attention. Anything having to do with the world around you—including your perceptual body—is categorized as part of the 'external schema' ('real world schema'). Of course there are infinite things that could be imagined (memories, the future, scenarios, concepts, stories), and all such 'non-veridical' information gets categorized into the 'internal schema' ('imagination schema'). And, the bank's modeling attention can briefly be brought to an object in either realm, or just use random shapes for scaffolding (perhaps this is the *bank's* 'autopilot').

So let's talk a bit more about rings—they can





## EXAMPLES OF THE EXTERNAL MODEL

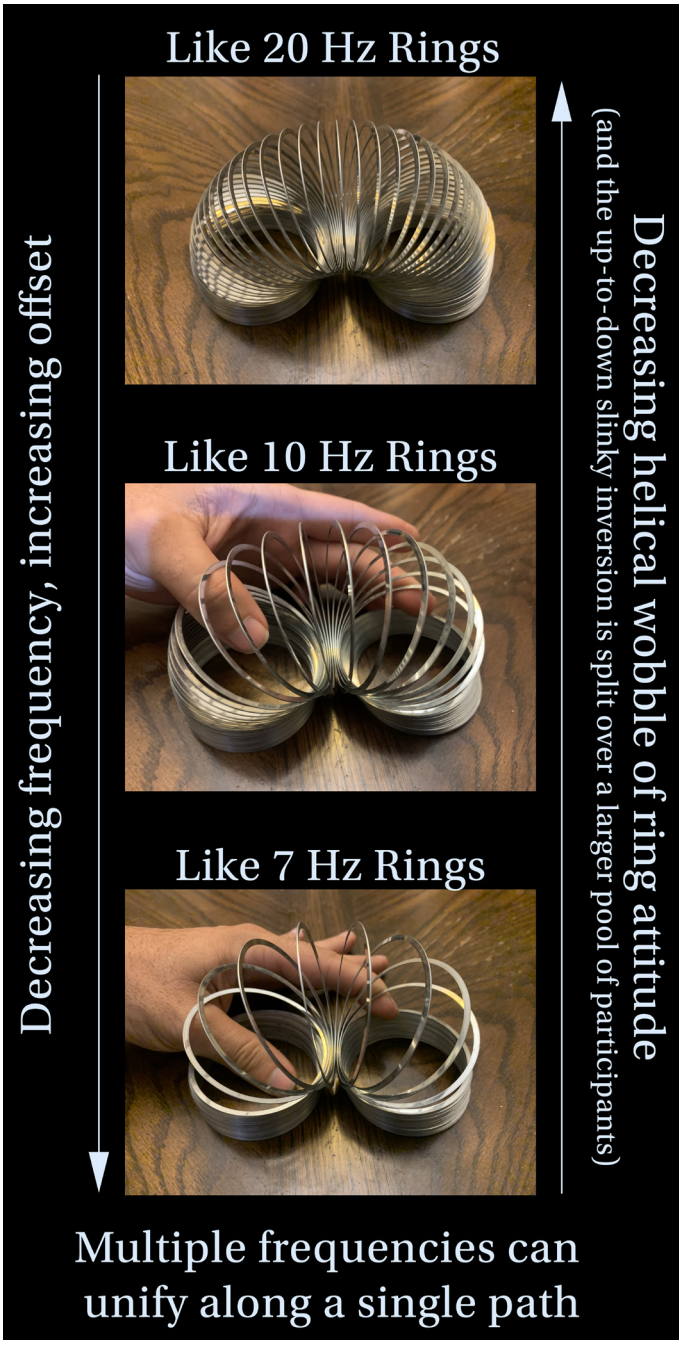
*The external model is information about the real world. It includes the colors of vision. It also includes the '3D direction' and sometimes the 'modal loation' of touches, tastes, sounds, and smells.*

*Top to bottom: Smith Mountain Fire Tower, Jackson's Gap, AL; Humphrey's Peak, AZ; Airport Mesa, Sedona, AZ; a view from the Appalachian Trail near where it crosses from New Jersey to Pennsylvania.*

change frequency ('print rate') in real time, changing smoothly from, say, 7 Hz to 10 Hz to 20 Hz. I think it is likely, though not yet proven, that Local Field Potential (LFP) cyclic maxima may correspond with these rings, for it would be the time when action potentials would be most likely to get through and affect plasticity potentiation.

If the sequence of 10–20 rings was walking across your perceptual volume like the consecutive rungs of a giant slinky (and changing course), then faster rings could fit in the same path as slower rings—this is a principle of ring behavior.

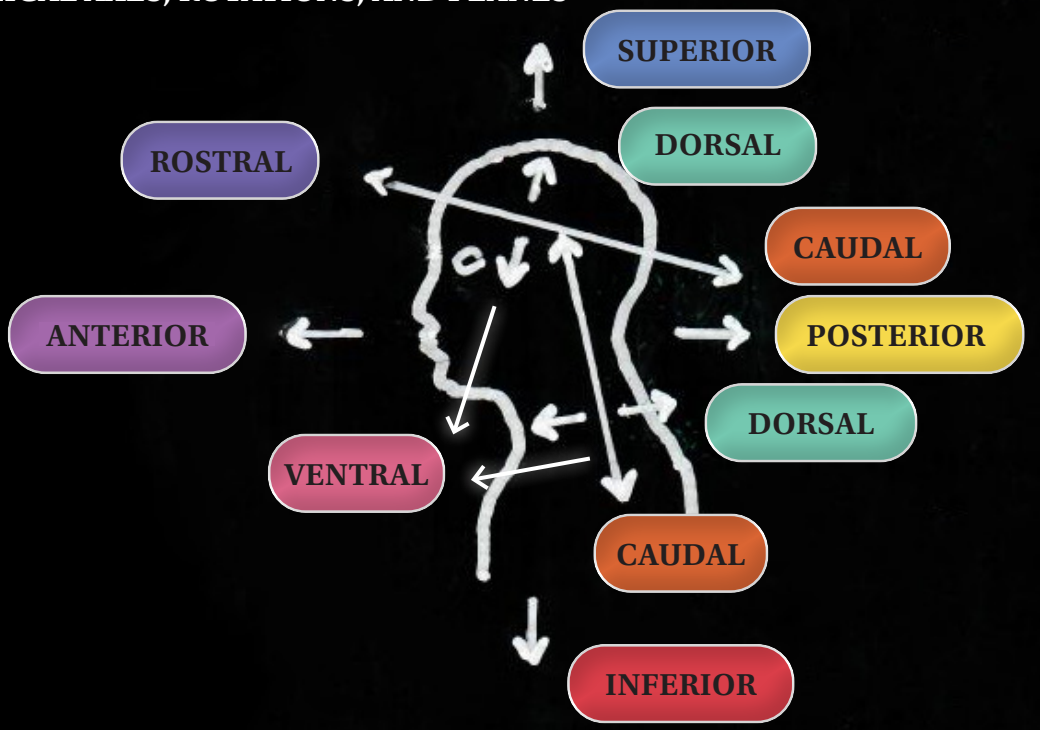
There seems to be, at any given millisecond, a particular 'ring shape template' that must also be used, and it changes over time. For example, if square 'rings' were the template, there wouldn't be one ring that suddenly decided to be a circle—the changes in ring shape happen smoothly.

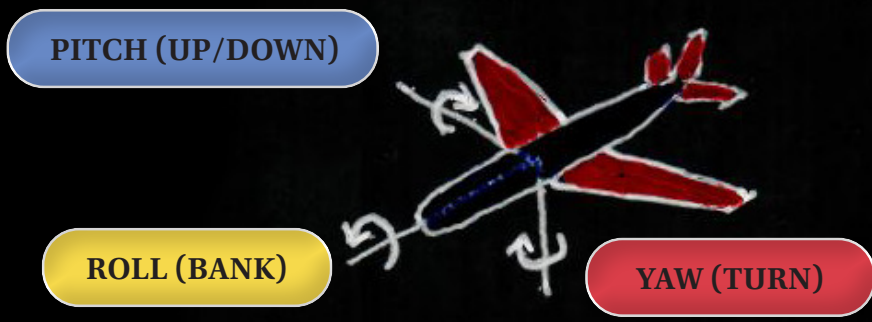


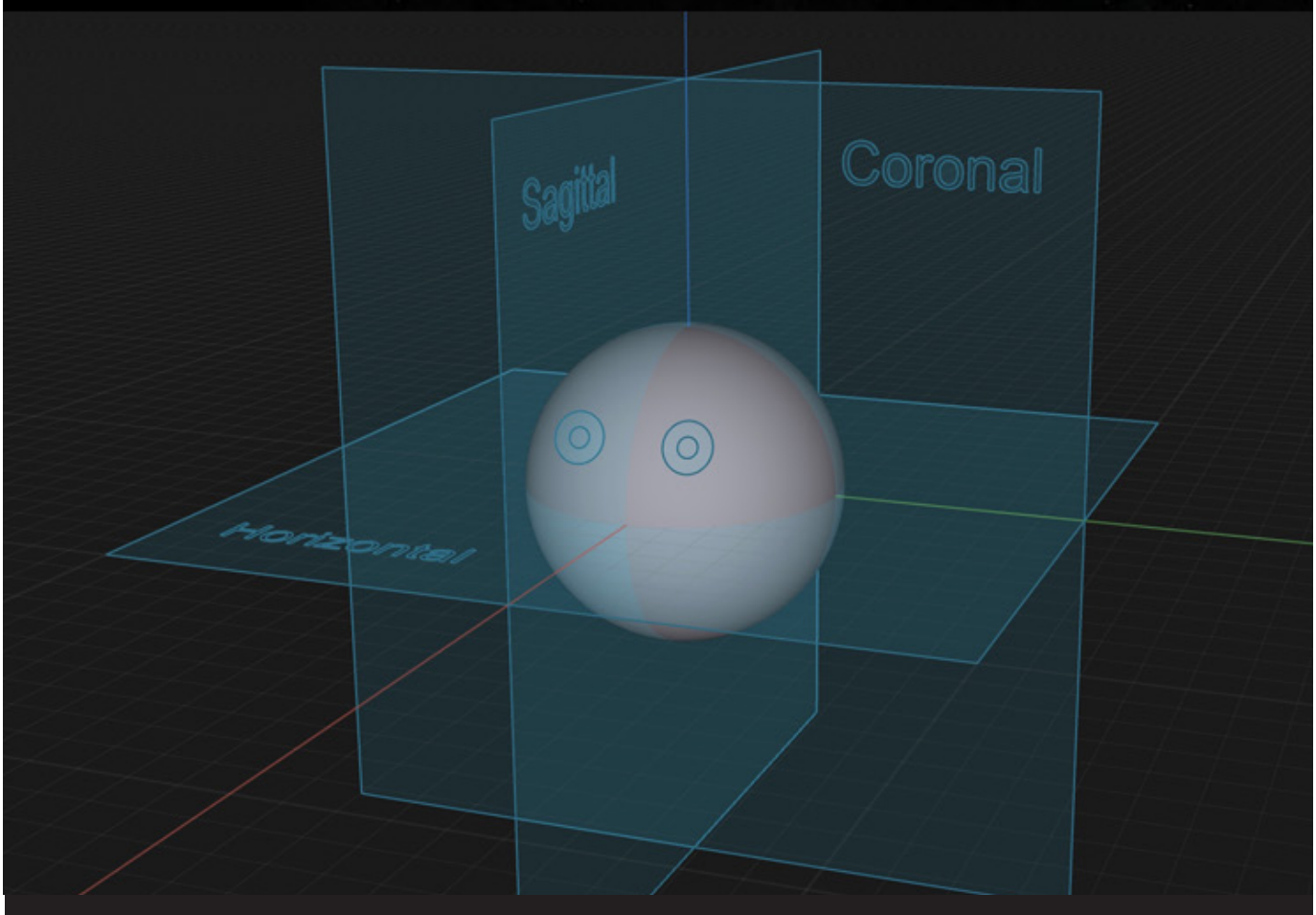

So, in this figure, the 'ring shape' is a circle, and the 'ring path' is an inverted U. The ring path constrains the smooth change of the orientation of the 'ring attitude' (the vector normal to the plane of a single ring). Three 'ring frequencies' are depicted: 7, 10, and 20 Hz.

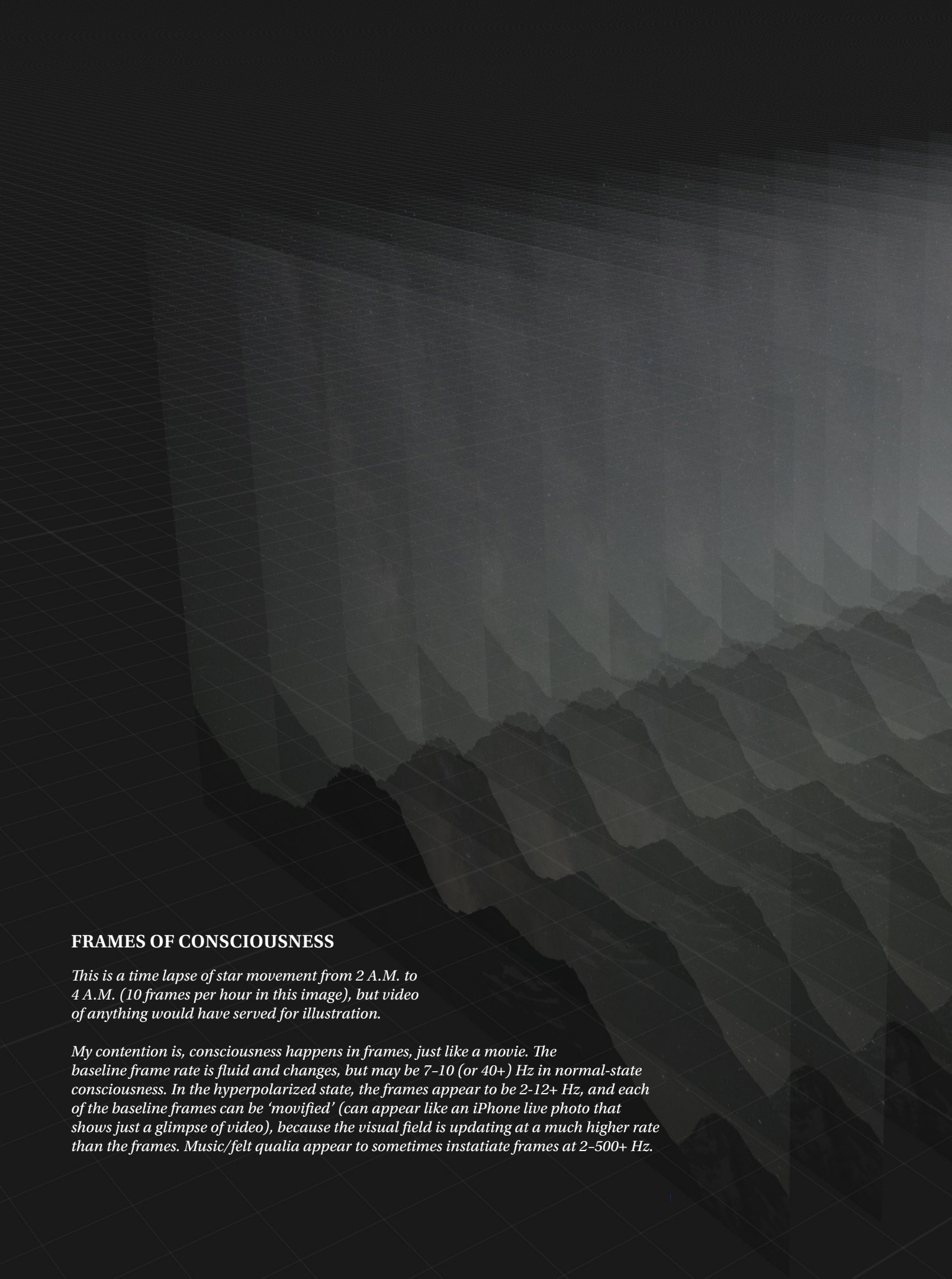
Anatomy terminology is explored to the right, as well as three types of rotation in 3D—pitch, yaw, and roll. Finally, the horizontal, coronal, and sagittal planes are denoted upon a head, with eyes facing forwards The rings and frames of consciousness can be referenced by whether their plane is close to '2D-parallel' with these planes. Rings may take a car's frame you're riding in as 'stability reference' (not your body)—the bank is '3D-parallel' to the car.

## ANATOMICAL AXES, ROTATIONS, AND PLANES



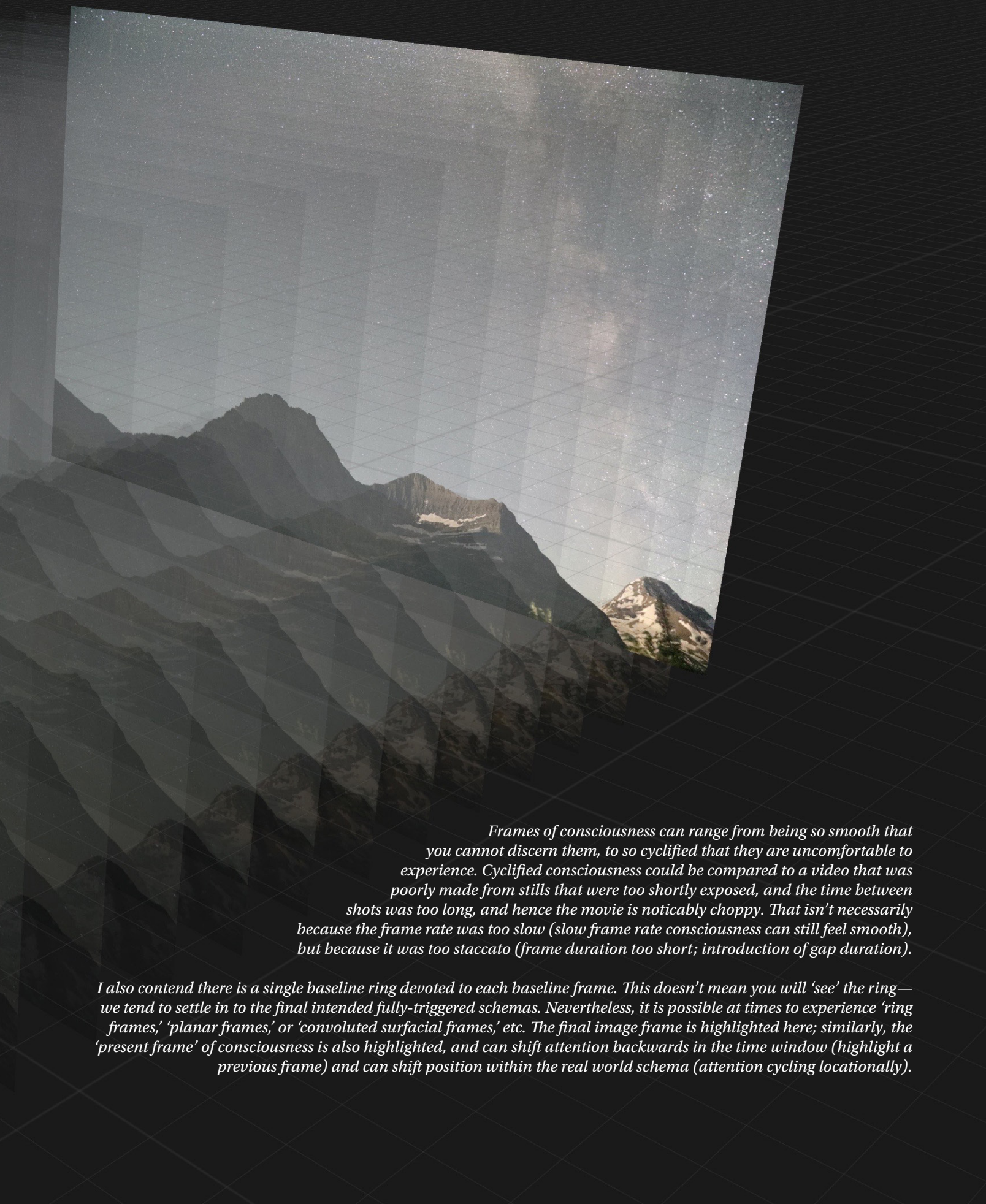





**FRAMES OF CONSCIOUSNESS**

*This is a time lapse of star movement from 2 A.M. to 4 A.M. (10 frames per hour in this image), but video of anything would have served for illustration.*

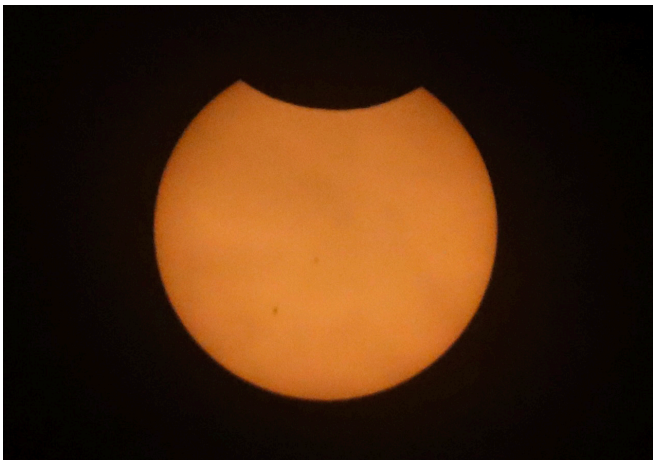
*My contention is, consciousness happens in frames, just like a movie. The baseline frame rate is fluid and changes, but may be 7–10 (or 40+) Hz in normal-state consciousness. In the hyperpolarized state, the frames appear to be 2-12+ Hz, and each of the baseline frames can be 'movified' (can appear like an iPhone live photo that shows just a glimpse of video), because the visual field is updating at a much higher rate than the frames. Music/felt qualia appear to sometimes instatiate frames at 2–500+ Hz.*

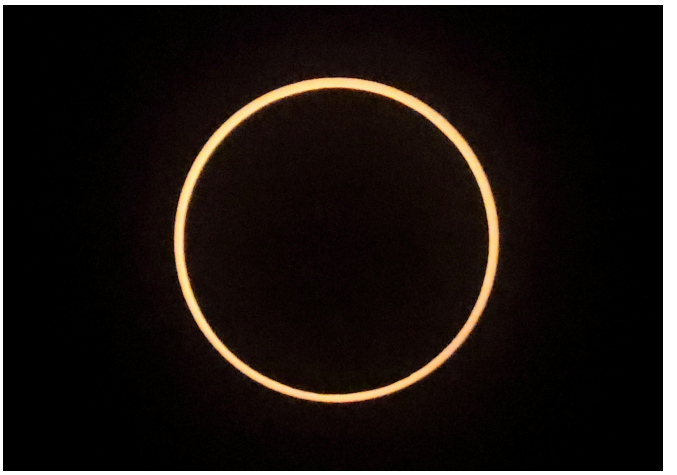


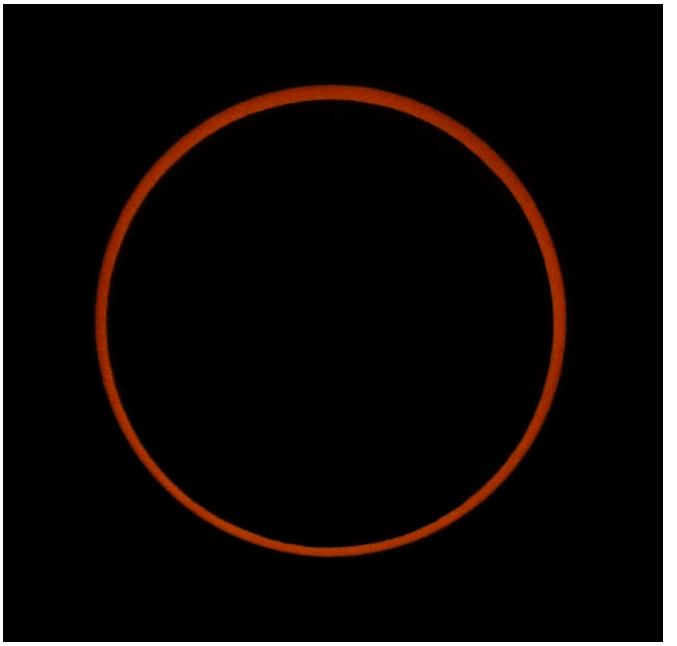
*Frames of consciousness can range from being so smooth that you cannot discern them, to so cyclified that they are uncomfortable to experience. Cyclified consciousness could be compared to a video that was poorly made from stills that were too shortly exposed, and the time between shots was too long, and hence the movie is noticably choppy. That isn't necessarily because the frame rate was too slow (slow frame rate consciousness can still feel smooth), but because it was too staccato (frame duration too short; introduction of gap duration).*

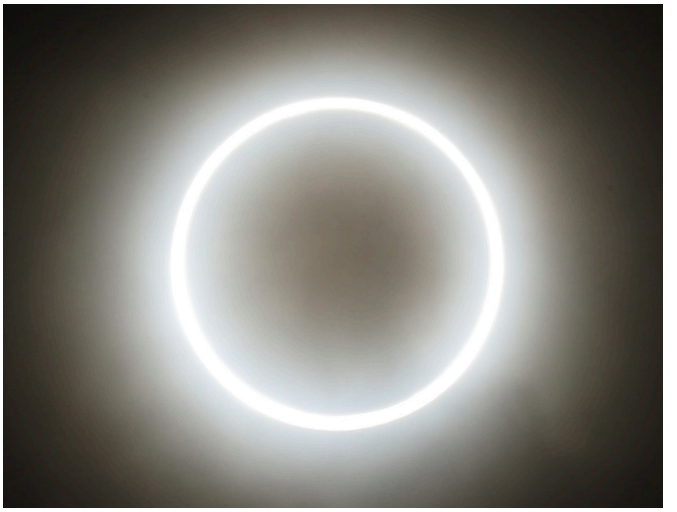
*I also contend there is a single baseline ring devoted to each baseline frame. This doesn't mean you will 'see' the ring—we tend to settle in to the final intended fully-triggered schemas. Nevertheless, it is possible at times to experience 'ring frames,' 'planar frames,' or 'convoluted surfacial frames,' etc. The final image frame is highlighted here; similarly, the 'present frame' of consciousness is also highlighted, and can shift attention backwards in the time window (highlight a previous frame) and can shift position within the real world schema (attention cycling locationally).*

I've thrown a lot at you in this chapter, so how about some eclipse and other photos as a palate cleanser as we wind this chapter down? These images came from the 2023 Annular Solar Eclipse (Corpus Christi Beach, TX), known (pun intended) as the 'Ring of Fire Eclipse.' Of course I don't have to tell you how much I like that name!









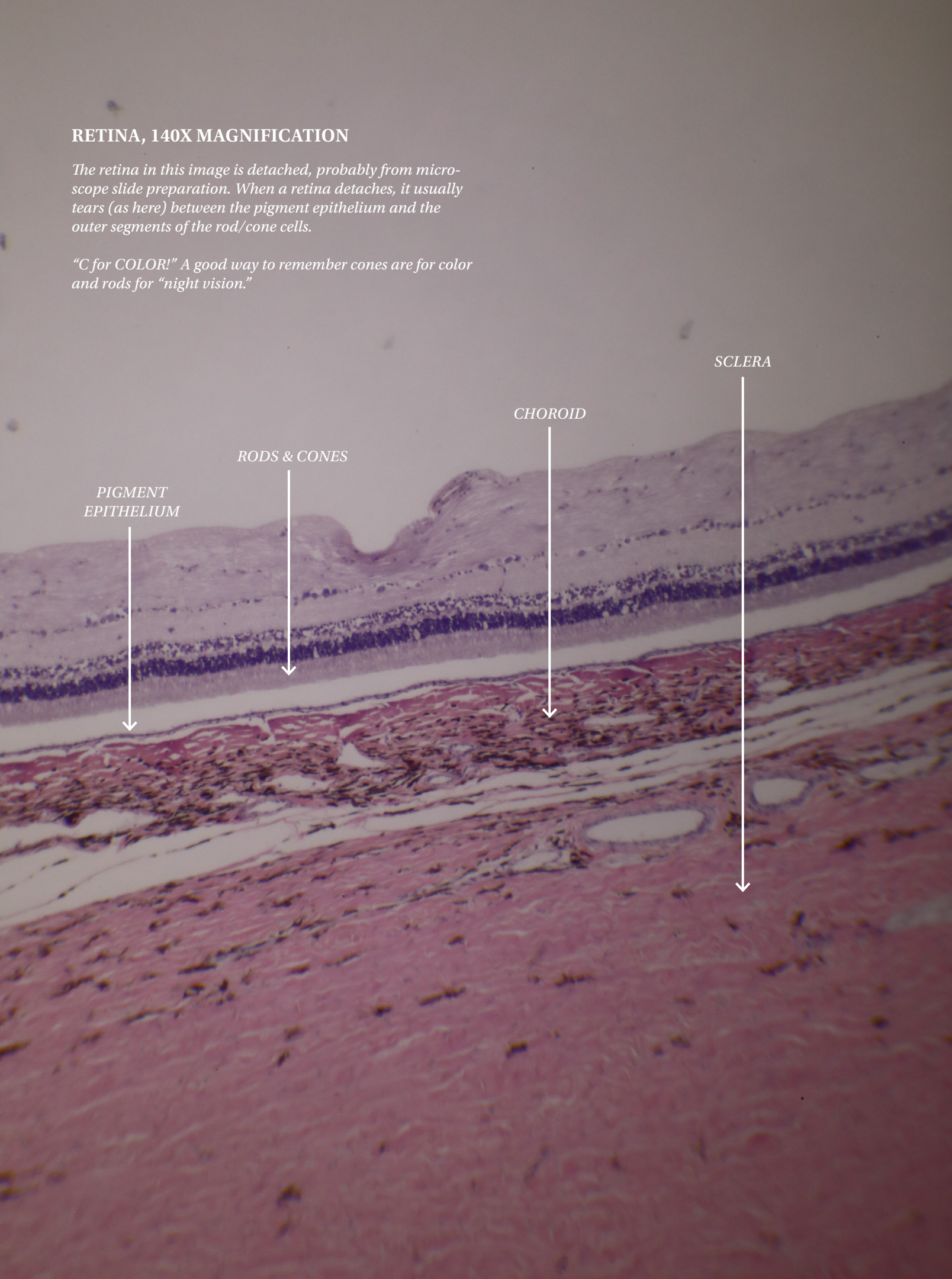
**Don't Burn Your Retina!**

By now, everyone knows not to look at an eclipse without the right gear. But have you ever wondered what your retina and eyeball look like? Well, wonder no more—you can shine a bright LED into the side of your eye to see blood vessel shadows reappear (cool trick, heard from David Eagleman). Or, if you just want to see a retina, then check out the images on the following pages.

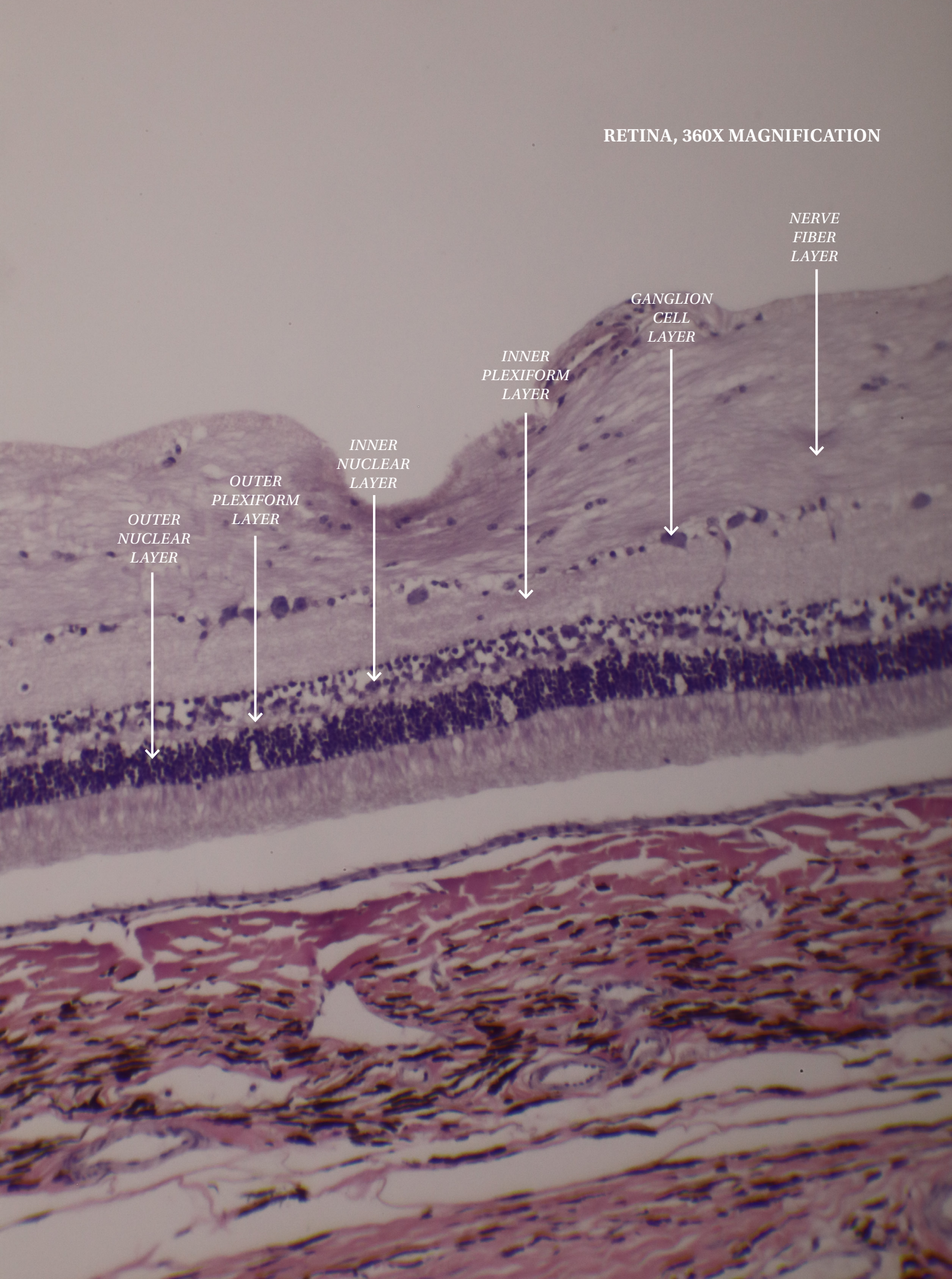
## RETINA, 140X MAGNIFICATION

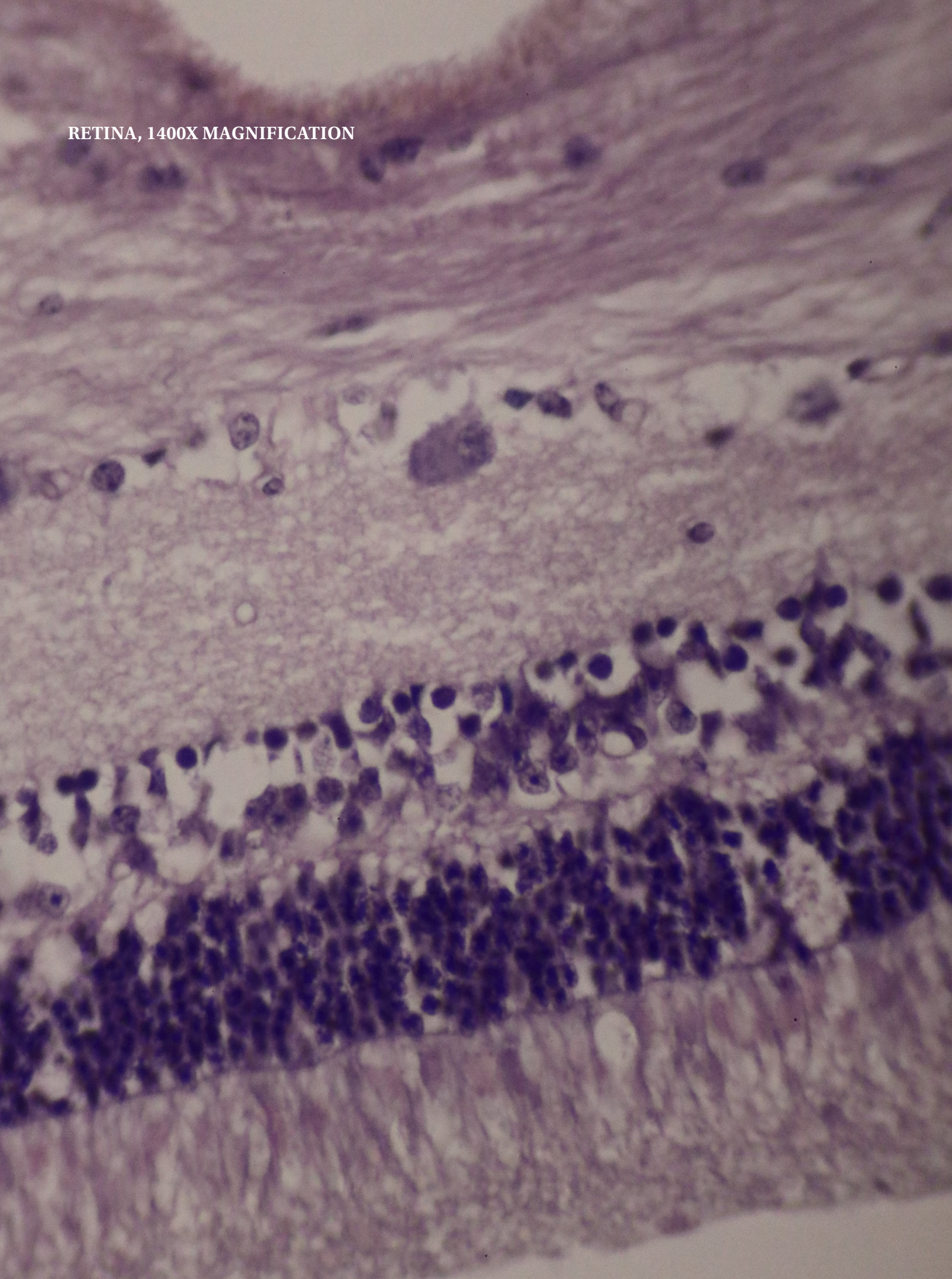
*The retina in this image is detached, probably from microscope slide preparation. When a retina detaches, it usually tears (as here) between the pigment epithelium and the outer segments of the rod/cone cells.*

*"C for COLOR!" A good way to remember cones are for color and rods for "night vision."*



**RETINA, 360X MAGNIFICATION**

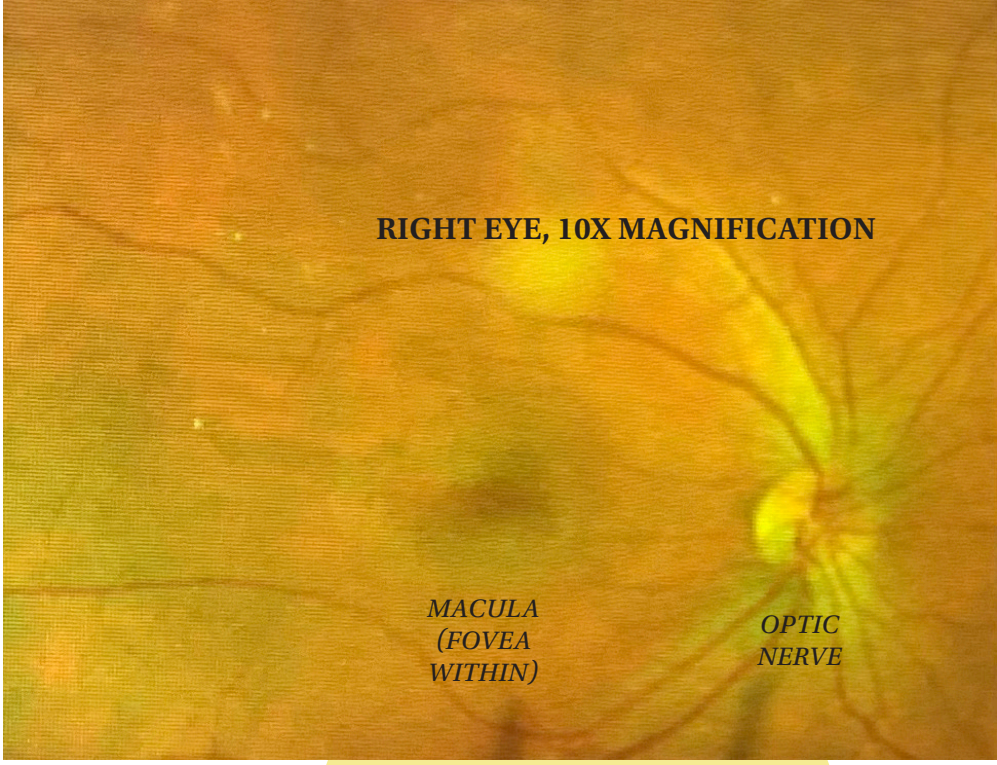


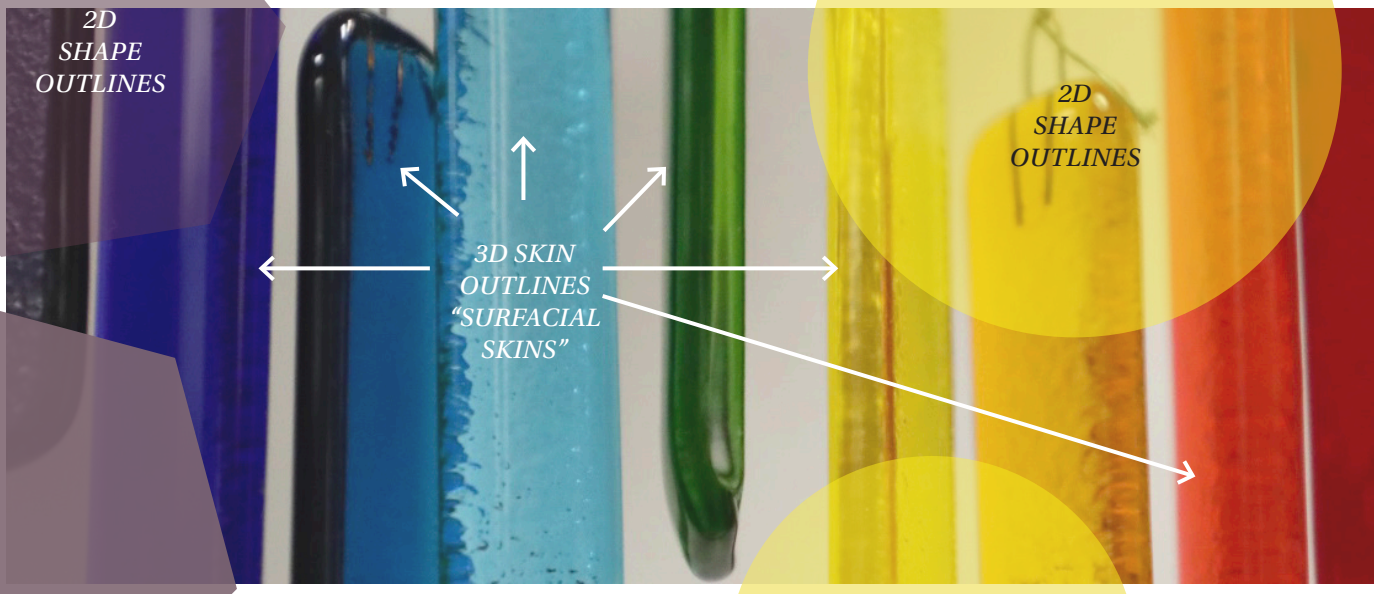


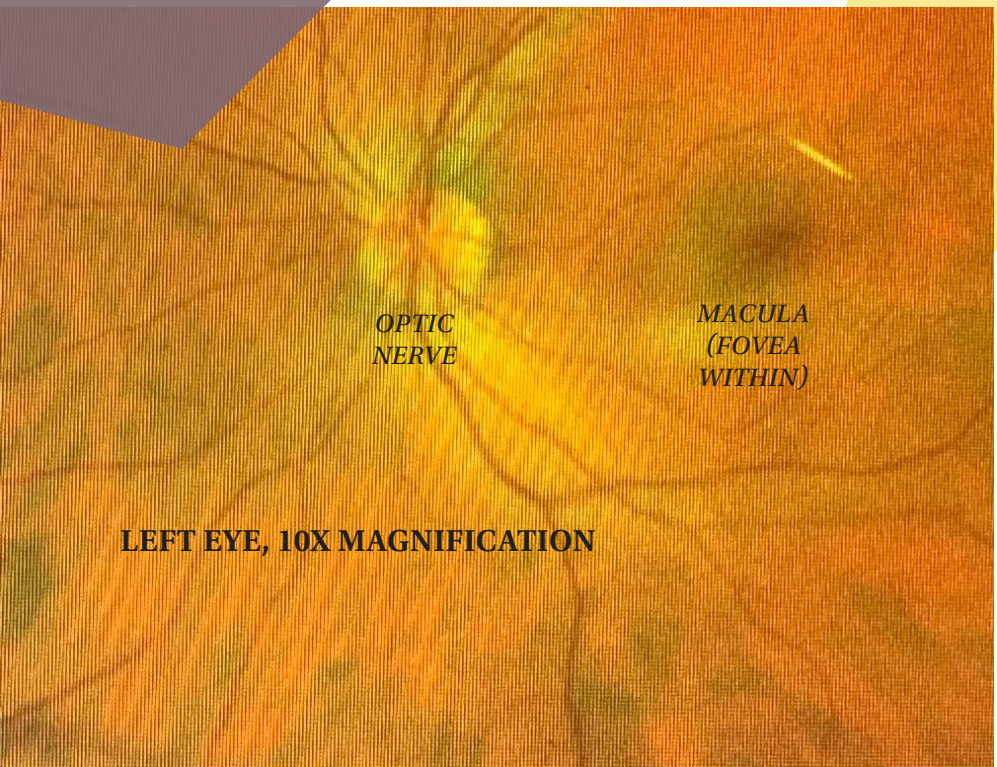
RETINA, 1400X MAGNIFICATION

Although our eyes capture light and therefore have only two dimensions to work with, the brain is able to 'cast' these rays back out into a perceptual model of the world that feels three-dimensional.

The process of going from 2D to 3D is still unknown in neuroscience, but there are some clues.




For one, each pixel duo (from left/right eye receptive field) is 'fused together' into a single pixel vector in V1. Then, from a cyclopean perceptual vantage point (between your left and right eye), the rays can be 'cast' into two overlaying 3D models, with disparities from focal point forward and back helping to give the feeling of depth.


## IMAGINING 3D SKINS

*Perhaps 'surfacial skin' would be more accurate than '3D skin' for the notion at hand; but, imagine that every boundary point between air and ground is illuminated, and made into a translucent surface, and everything else culled out. You'd be left with a larger-than-life raised relief topological map, right? That's what is meant by '3D skin' or 'surfacial skin.' Calling it 3D is a bit imprecise, because it's 2D in thickness, just extremely morphed and stretched, and with all kinds of fine details (smaller rock surface variations), and needing 3D of space to exist.*

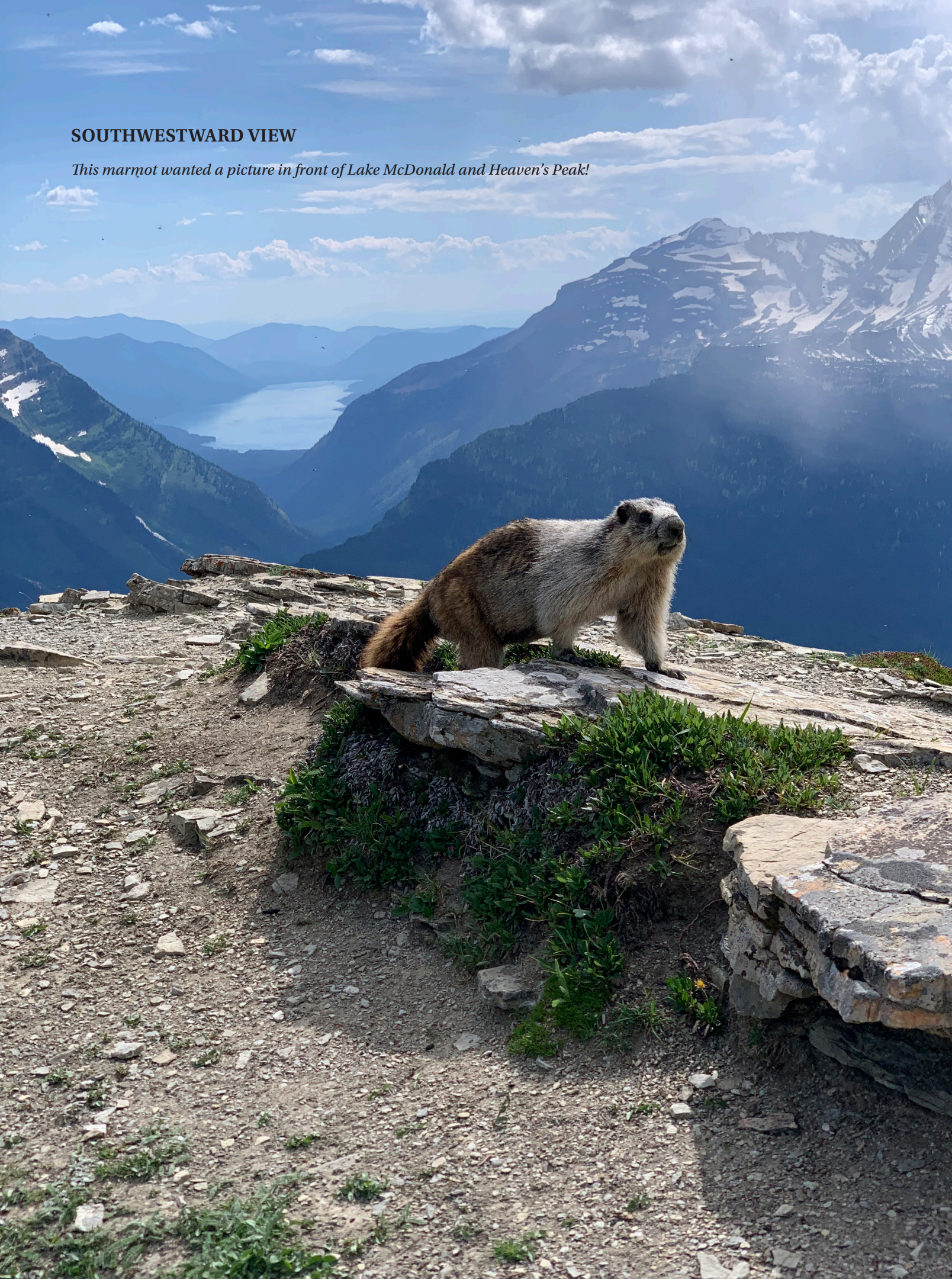
**SOUTHWARD PANORAMA — GLACIER NATIONAL PARK (GARDEN WALL TRAIL)**

*This may have been the most beautiful hike of my life, but at nearly 15 miles of length, it was exhausting! This picture is taken from the Grinnell Glacier overlook. Salamander Glacier is also visible, closer to the bottom of the photo. Lake McDonald is visible above this text (to the right), and Heaven's Peak is visible at the far right. Taken 7/23/22.*

*Next two pages show pictures from essentially the same lookout.*

**NORTHEASTWARD VIEW**

*From close to far, Upper Grinnell Lake, Grinnell Lake, Lake Josephine, Swiftcurrent Lake.*



## SOUTHWESTWARD VIEW

*This marmot wanted a picture in front of Lake McDonald and Heaven's Peak!*

**The Bank — Solar Analogy**

The bank stands as one of the most enigmatic elements of consciousness, shrouded in an aura of mystery. It carries the suspense of a thriller, where the outcome is tantalizingly uncertain—it represents the ability to print the experience of anything that can happen to you in life. The intensity of the bank is akin to witnessing a solar eclipse; you had no idea the mere outskirts of the sun were so potent; likewise, whatever is being revealed by the bank is likely just 'leakage' revealing a tiny bit of its sheer obscenity! These are images from Spring City, TN, of the August 21, 2017 solar eclipse.

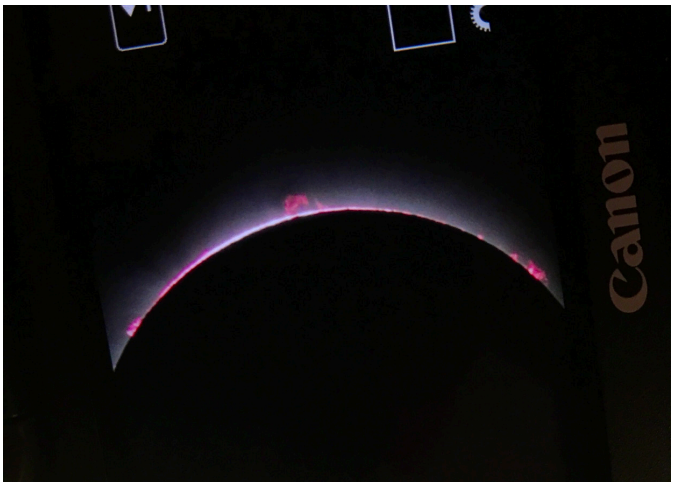
Ring shapes trigger similar ring shapes. Could there be a way to compare similar morphological structures among rings and skins, and also to trigger via artificial groupings? The hippocampal trisynaptic loop, is presented in a few pages. Papez' circuit features mammillary bodies, cingulate, etc.

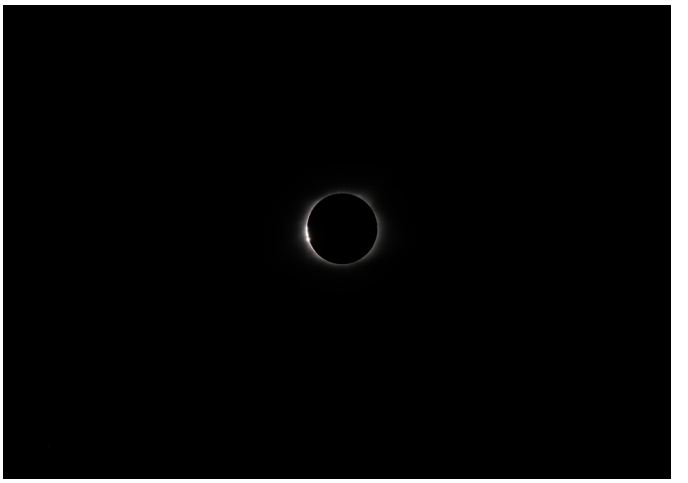
The bank exhibits remarkable versatility — it can duplicate itself, mirroring the dynamics of a rotor spinning against a stator. It's capable of representing various orders of spatial magnitude and replicating identical shapes across different scales. Whether as a diminutive or expansive rotor, it adjusts its frequency of revolution even within

## GREAT AMERICAN ECLIPSE OF 2017

*By the time half the sun is occluded by the moon, it is as if someone has walked between you and a bonfire, blocking the radiant heat. You can sense the decrease in infrared light hitting your skin. The sky gets darker, and casts a nearly twilight hue over the landscape until, by totality, you can make out stars in the sky.*

*Facing: The corona of the sun becomes visible when it is no longer 'overexposed' and blown out by the sun proper. Three distinct axes of corona are visible here.*

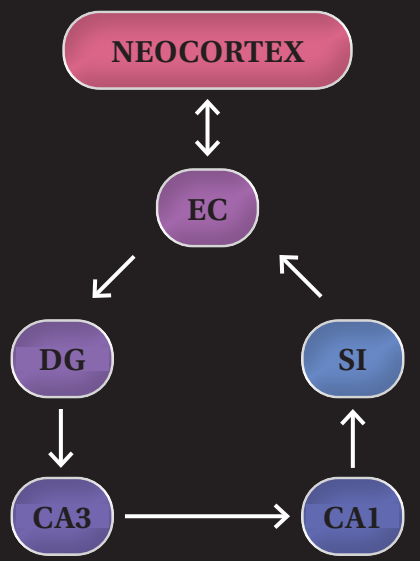

Canon



the confines of a single ring. Have you ever considered that the various 'characters of consciousness' might actually be facets of a single entity wearing different masks? Which one, you ask? The ring is central. Yet, when we speak of the ring, aren't we essentially referring to the bank? It's the ultimate artist, painting our experiences and archiving any memory vivid enough to endure (thanks to Long-Term Potentiation). What are your thoughts? Could the bank be the elusive matrix, the key to deciphering the brain that has long baffled us? I'm persuaded that it is. In my view, consciousness arises from the bank's ability to craft inertial geometric forms and track their evolution through time. However, the mystery of how the bank itself is structured in space remains unsolved.

**HIPPOCAMPAL TRISYNAPTIC LOOP**

*Starting at the neocortex, move to the entorhinal cortex (EC); then go along the 'perforant path' to the dentate gyrus (DG); along the 'hippocampal mossy fibers' over to CA3 (Cornu Ammonis, 'ram's horn' — part of the hippocampus proper); next, take 'Schaffer's collateral' to CA1; exit the hippocampus proper and travel to the subiculum (SI, meaning 'support' due to being under the hippocampus); as you then go back to the entorhinal cortex and back to the neocortex, you complete the circuit. It is said that the DG does pattern separation, CA3 does auto-association, and CA1 does pattern completion.*




**FACING PAGE: ASPECTS OF AN ECLIPSE**

*Upper left: Solar flares visible on screen of camera. I used a Canon 5D Mark IV with a 100-400 mm telephoto lens.*

*Upper right: 'Bailey's Beads,' visible on left side of moon, where valleys in the lunar surface allow more sunlight to come through and appear as beads.*

*Middle: With sun at a crescent phase, gaps in the leaves allowed the crescent-shaped ½°-tall sun to create crescent-shaped ½°-tall illuminations within the shadowy regions under trees. I'd estimate the distance from the branches to the ground here varied from 10-25' to provide these varying 2-5" tall crescents which all share the same ½° angular spread—remember the example that a single angular spread traces differing physical sizes based on axial—or radial—distance.*

*Lower left: The exiting 'diamond ring' phase of the eclipse where the sun begins to peek out from behind the right side of the moon and liberally overexpose a tiny region of view, giving the appearance of a diamond.*

*Lower right: Just after the diamond ring phase, more sun peeks out, forcing the use of a solar filter placed over the end of the lens to protect the camera and photographer. While this orange sliver looks less powerful than the diamond ring, it is actually more so.*

# 2

## *The Binding Problem*

*Almost everything we do, we do better unconsciously than consciously.*
*—Bernard Baars, Global Workspace Theory (GWST)*

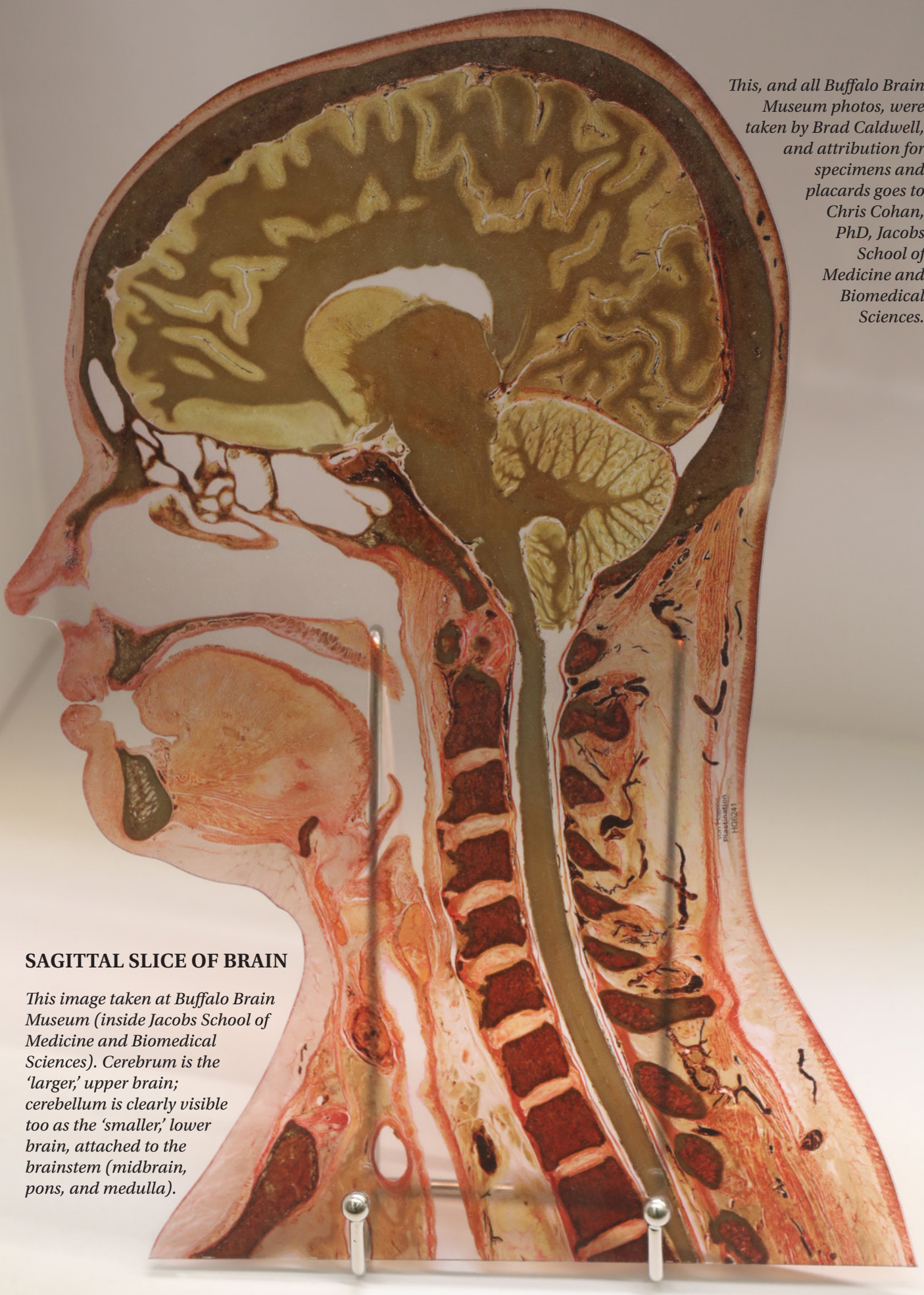
Imagine the brain as an enigmatic orchestra, composed of trillions of microscopic synapses, each so minuscule and isolated that the notion of them 'seeing' one another seems almost fantastical. Yet, from this intricate web of near-infinite connections and locations, there emerges a singular, unified consciousness. How does this happen?

Where is this integration, and how does the brain read, interpret, consider, and respond appropriately to the impressions? We will first break down ***three mechanisms of agency*** found in the brain: (A) conscious control, (B) autonomous, autopilot, 'rut' control, and (C) bottom-up, knee-jerk control (e.g. via colliculi in the brainstem).

But we must explore ***three processes*** these mechanisms of agency are acting on: (1) perception (agency can only point sensors in various directions, open/close eyes, plug ears, etc.—low-level control), (2) geometry/attention (veridical or 'mental'[9] imagery to convey experience and judge desirability of potential actions combined with rumination), and (3) response. This is simplified and may have a little overlap, but gives us a good starting point.

And, we must consider ***five requirements of the binding problem***: (I) geometrical unity (inclusion of external and internal imagery into one experience, likely combining output from multiple brain regions), (II) agency unity (entire organism on page to act as a single self, single-purposed agency stream), (III) time point unity (no echo, millisecond resolution), (IV) time flow unity (coherence/unity across working memory), and (V) time span unity (medium and long term memory to enable new consciousness to have awareness of old consciousness).

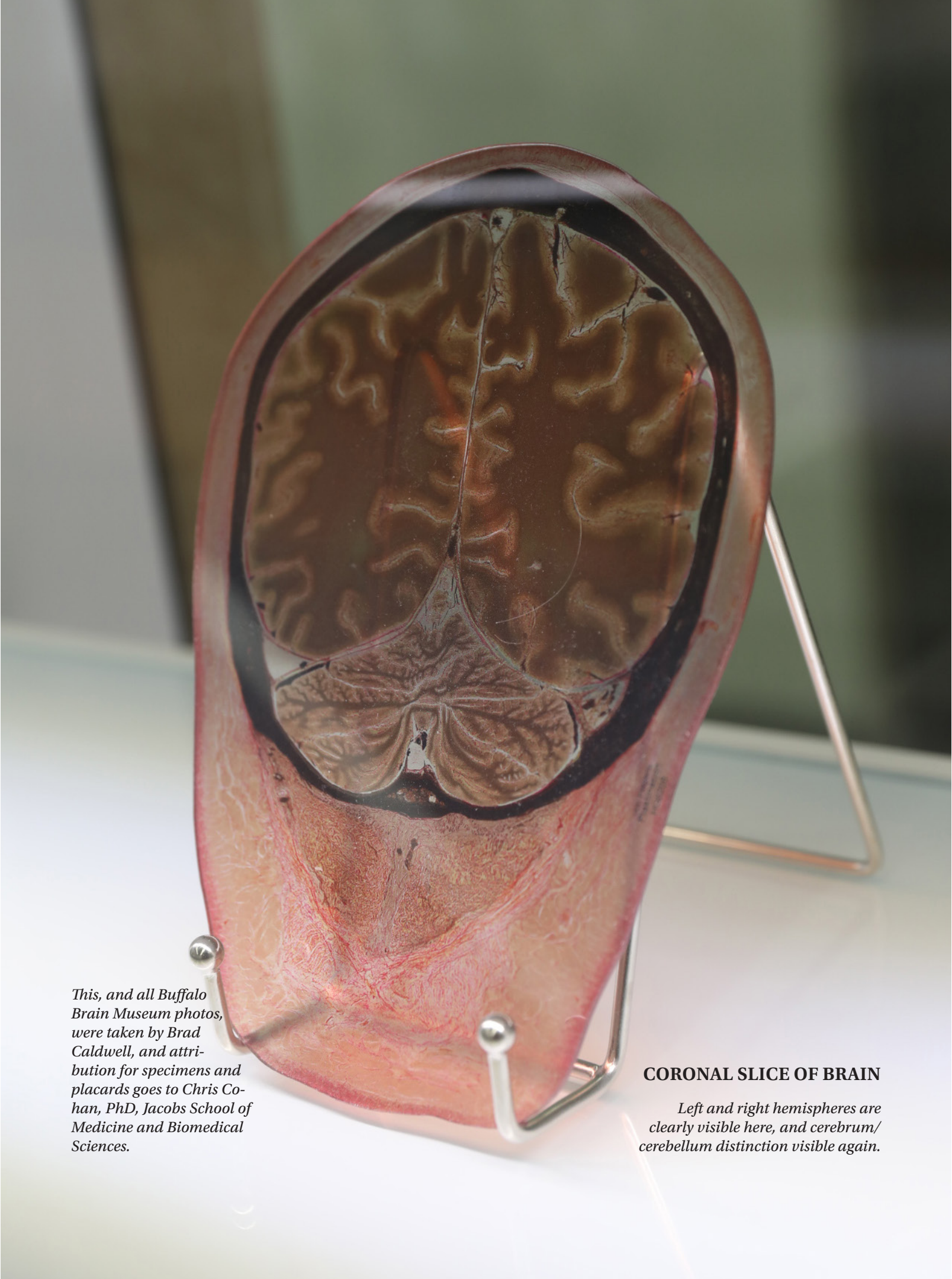
9 All imagery is actually mental. Even the avatar (what you think is your body) is a mentally-constructed model, to be pedantic—but a plenty-accurate model of the physical body!



*This, and all Buffalo Brain Museum photos, were taken by Brad Caldwell, and attribution for specimens and placards goes to Chris Cohan, PhD, Jacobs School of Medicine and Biomedical Sciences.*

**SAGITTAL SLICE OF BRAIN**

*This image taken at Buffalo Brain Museum (inside Jacobs School of Medicine and Biomedical Sciences). Cerebrum is the 'larger,' upper brain; cerebellum is clearly visible too as the 'smaller,' lower brain, attached to the brainstem (midbrain, pons, and medulla).*



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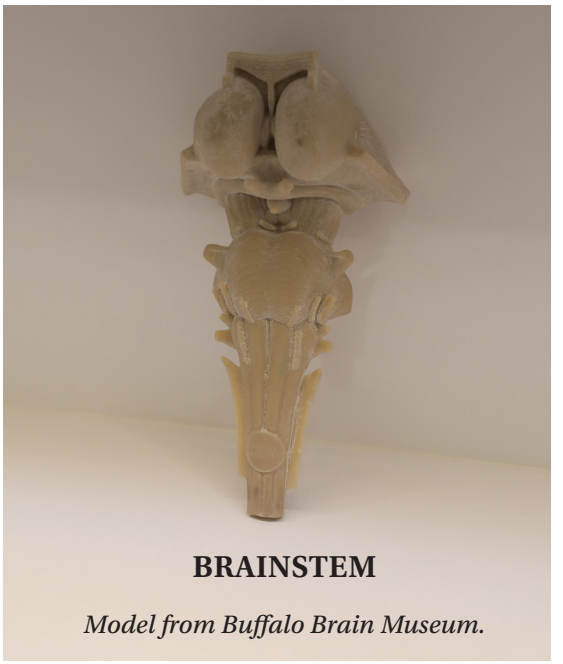
**CORONAL SLICE OF BRAIN**

*Left and right hemispheres are clearly visible here, and cerebrum/cerebellum distinction visible again.*

| Component | Description | Control |
|---|---|---|
| Perception | Bottom-up sensory input; alterable by actions like head movement. | Bottom-up, with conscious redirection. |
| Geometry | Cartesian 3D scaffolding: dots, rings, surfaces, object point clouds, scene topologies, perspective impingement/focus. | Autonomous/bottom-up, with some conscious steering. |
| Response | Actions/reactions of avatar and the not-directly-observable body its movements are mapped to. | Mix of autopilot, bottom-up, and conscious control. |

So let's first understand the tripartite nature of consciousness: ***(1) perception***, which is a bottom-up feed of the visual field and basic sensations (yet can be influenced by consciously turning one's head); ***(2) geometry***, a parallel thread that provides Cartesian 3D scaffolding for our experiences, capable of rendering everything from a simple dot tracer, to intricate rings, to surfacial frames, and even to complex objects and scene topologies—these often manifest as low-resolution, translucent constructs within our subconscious, consisting of bare 'location awareness'; and ***(3) response***—another thread parallel to perception and geometry. It is crucial to acknowledge that the threads of geometry and response often function autonomously, or get driven by bottom-up processes, but may be transiently placed under conscious micromanagement. There is a constant hand-off between ***(A) conscious influence, (B) autopilot, and (C) bottom-up capture*** of: (2) geometry/focus and (3) behavior.



**BRAINSTEM**

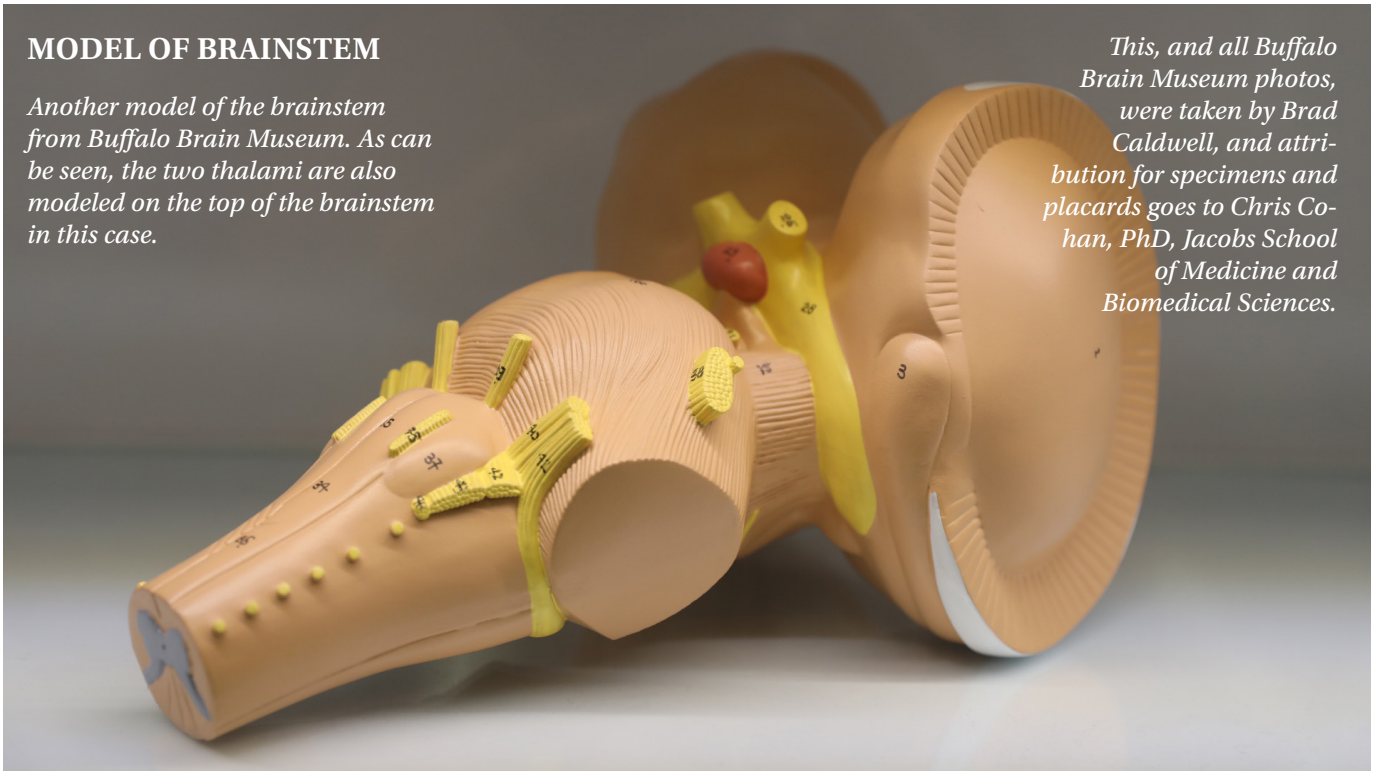
*Model from Buffalo Brain Museum.*

Now let's move on to binding constraints. Binding presents us with certain 'knowns'—invaluable constants that help narrow our quest for the mechanisms underlying consciousness. The first such requirement is ***(I) geometrical unity*** (or the inclusion of more than one information realm into a single overarching information realm which I call the 'fusing schema'). The information of schemas is largely geometrical, so alignment into a single Cartesian space will be similarly geometrical. The output of multiple brain regions

computing this geometrical information must be included/aligned. Of course, this is where rings shine, for it would be impractical to align every voxel point of every schema every millisecond—better to ring-path-integrate a series of single points (each millisecond fuses one point from each schema; 100 milliseconds can fuse an entire ring of points; 1 second can fuse a whole sweeping 'walk' or 'refresh' of rings, enabling the full understanding of the overlaid schemas—which aren't 3D images, but instead are 3D videos).

An enlightening glimpse into the tearing apart of these geometric schemas is seen in dissociation—the higher conscious self comes unglued and siloed off from the avatar schema (a component of the real world schema), losing sensation and control of the avatar. The neural correlate might be lost connectivity between prefrontal and posterior parietal cortices, perhaps due to phasic LFP anti-correlation.

In the layered architecture of consciousness, the primary cortices lay the groundwork, quietly handling sensory data in a (separately conscious?) realm apart from our conscious narrative. Ascending to the higher levels, the avatar and environment schema, orchestrated by the posterior parietal cortex (PPC), typically works in concert with the prefrontal cortex (PFC), our command center for conscious thought and self-awareness. However, in the peculiar state of dissociation, your intimate connection to bodily sensations and the direct first-person perspective is severed. You continue to monitor the avatar's interactions—like a director observing from behind the scenes—without feeling the sensations or controlling the actions. The PFC watches the mind's eye view. While the PPC may operate autonomously, its consciousness—if it has any—is temporarily siloed. This suggests a complex partitioning of consciousness, where the PPC could be conducting its own conscious or subconscious processes independently, leaving us



**MODEL OF BRAINSTEM**

*Another model of the brainstem from Buffalo Brain Museum. As can be seen, the two thalami are also modeled on the top of the brainstem in this case.*

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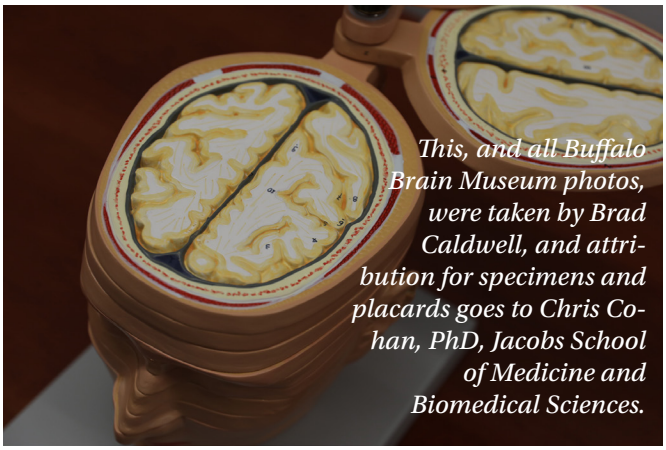
| Binding Requirements | Description | Disruption |
|---|---|---|
| **Geometrical Unity** (Single Fusing Schema) | Multiple schemas (real world [avatar + environment], bank, imagination) are overlaid in a single fusing schema for inclusion. | Dissociation—temporary loss of conscious awareness/control of avatar (and therefore of body). |
| **Agency Unity** (No Fighting) | The entire conscious part of the brain acts as a single agent to direct the multicellular organism. | Split-brain patients—hands fighting over toy blocks; conscious bi-tasking (draw circle and square simultaneously). |
| **Time Point Unity** (No Echo) | Each note of a song is heard or placed into conscious display only one time despite discrepancies along the feedforward path. | No known cases. |
| **Time Flow Unity** (Sufficient Working Memory Buffer to Sustain Complex Meaning) | Consciousness builds from a few simple bits of information exponentially upwards to full schema. | ADHD as a slight example of disruption, with difficulty in sustaining attention and working memory. |
| **Time Span Unity** (Medium and Long Term Memory: Triggerable Recall and Identification of Consciousness Past As Same Entity) | Allows for continuity of self across time through memory recall and identification of past experiences with current consciousness. | Clive Wearing encephalitis of hippocampus, left temporal lobe, and prefrontal cortex. He kept a journal with repeating entries expressing that he was alive and conscious for the first time ever. |

to question: does the avatar, our PPC, possess its own separate consciousness in these moments, or is it merely executing learned behaviors without awareness? The answer remains an enigma.

A second requirement from binding is that we observe a ***(II) unity of agency***. Even when we engage in internal debate, there's a cohesive unity to our experience. Each thought, regardless of its content, is part of a singular stream of consciousness. Consider the split-brain phenomenon: severing the corpus callosum, which links the hemispheres, results in a divided consciousness, akin to two individuals vying for dominance. This can lead to the comical sight of one hand battling the other for a set of toy blocks, as if each were

**HORIZONTAL BRAIN SLICES MODEL**

*A model present at the Brain Museum in Buffalo, NY.*



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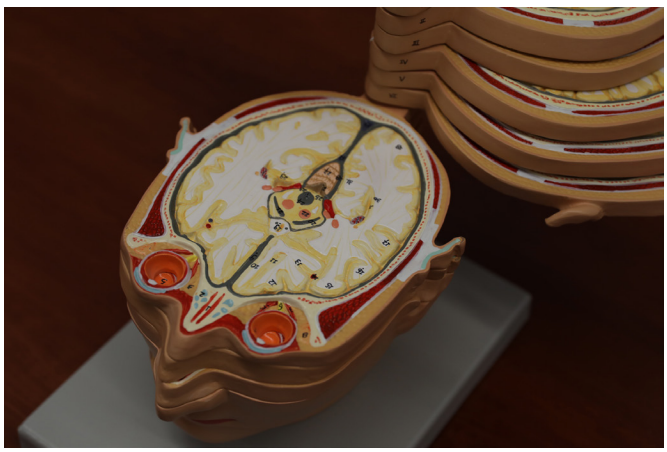
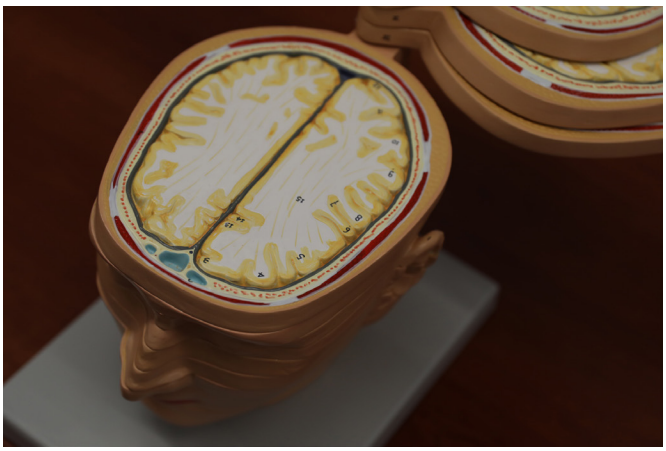
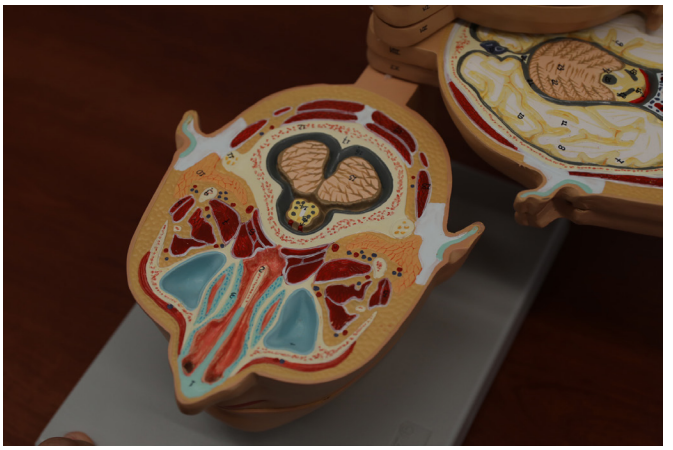
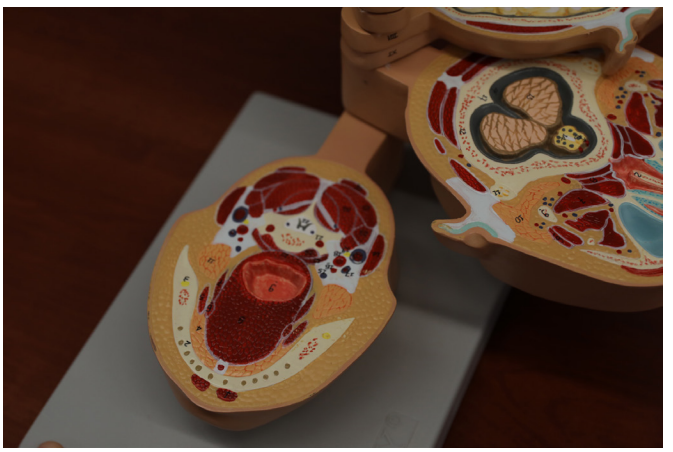
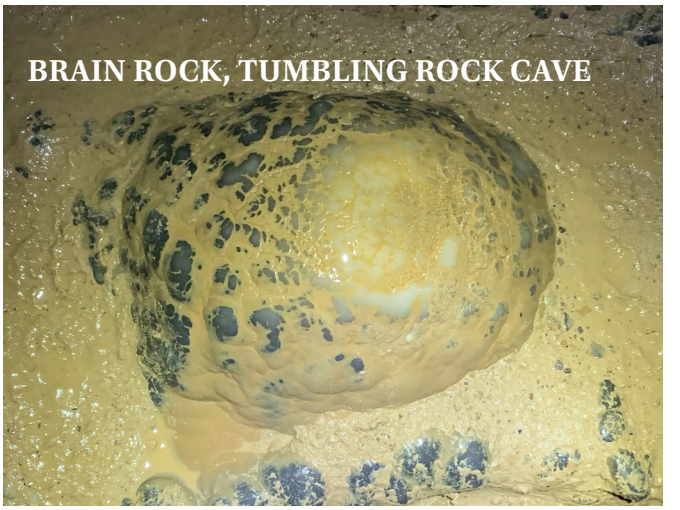




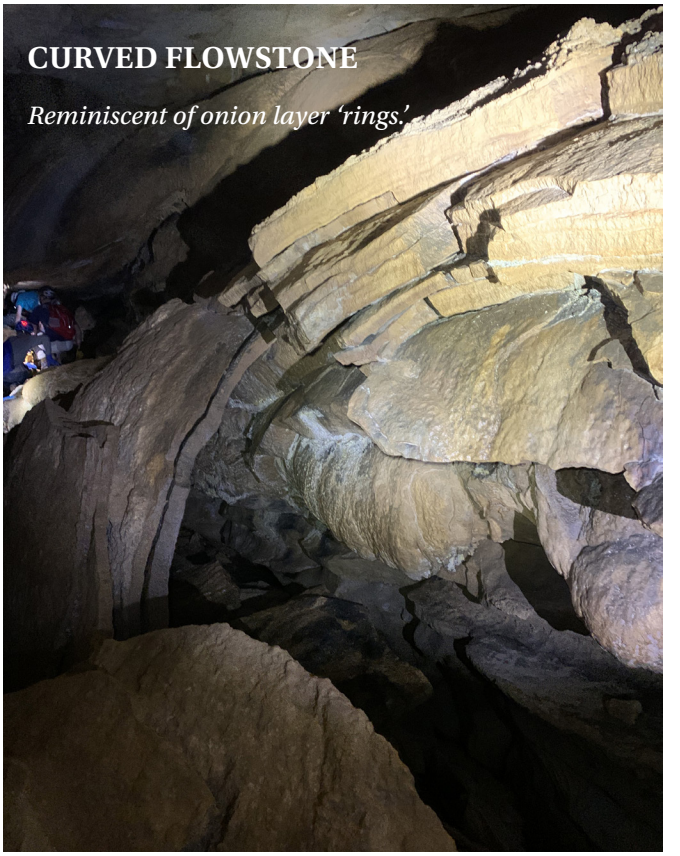
*Buffalo Brain Museum.*







**BRAIN ROCK, TUMBLING ROCK CAVE**



**CURVED FLOWSTONE**

*Reminiscent of onion layer 'rings.'*

puppeteered by a distinct will. Yet, this separation has at least one perk—it allows conscious multi-tasking, such as simultaneously drawing a circle with one hand and a square with the other!

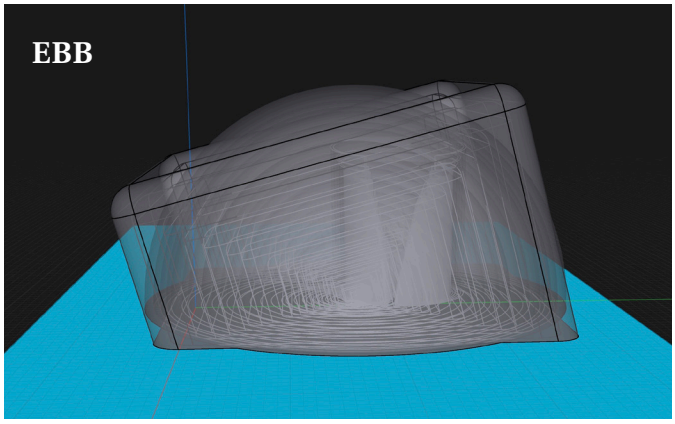
A third binding requirement is ***(III) unity of timing***. Consider the journey of music—simple sounds travel through the ear and set neurons firing along a path from the brainstem to the auditory cortex, and finally to the prefrontal cortex. We 'hear' this note without echo or repetition, a pristine auditory event amidst a sea of conflicting

neural latencies. This is the puzzle of experience: a world where myriad sensory inputs, each processed in different cerebral realms, somehow coalesce into a coherent whole.

There is also, fourthly, ***(IV) unity across working memory or time flow***. Imagine the onset of consciousness as akin to starting a lawn mower or a car: it doesn't roar to life with a single turn. Instead, it requires a sequence of rapid rotations, a 'turning over' that must reach a critical frequency before the system can feed back into itself and self-perpetuate.

Consider this 'starting' process in the brain as a tracer moving from point to point along a ring—a mechanism simple in its components but intricate in its function. In the briefest moments, spanning mere milliseconds, consciousness flickers on with just a few elemental pieces of information: a sequence of spatial points, a trajectory of the path, beginning to paint out the 3D scene. Yet, as these moments build up over a second, with successive rings contributing their part, the entirety of consciousness comes back online. From the simple awareness of a voxel point in your chest to the full realization of your presence in a room, the complexity of conscious experience compounds exponentially.

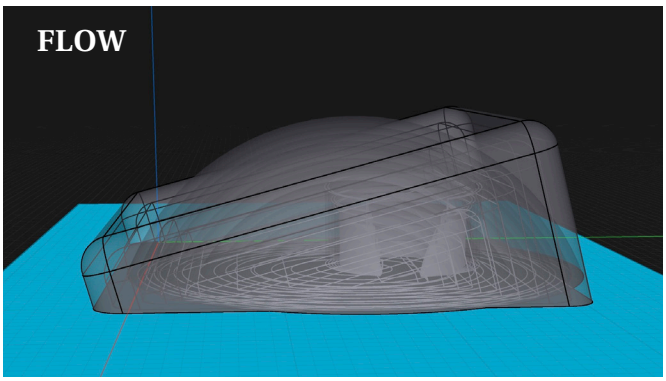
It's an avalanche effect—consciousness doesn't emerge from an abundance of information all at once. Rather, each small, elemental piece of data sets off a chain reaction, leading to richer connections and a deeper understanding. By the time a few rings have passed, what started as a trickle of awareness becomes a torrent of cognition, and we find ourselves fully immersed in the vivid reality of our own making. And there is not only the need for a buffer or a form of working memory—the brain also needs a sophisticated long-term storage system capable of retrieving and integrating long-term semantic, episodic, procedural, geometric, and emotive memories.




But as we were saying, consciousness has an ability to hold on to information bits until enough are obtained to pattern-match and complete the schema, not unlike a 3D-video-puzzle version of 'Hangman' or 'Wheel of Fortune.' And we see a progression—that one 'letter' (voxel in our case) with its identity ('so and so voxel in your right elbow') can begin to unlock some pattern matches (exponential understanding growth up to the full

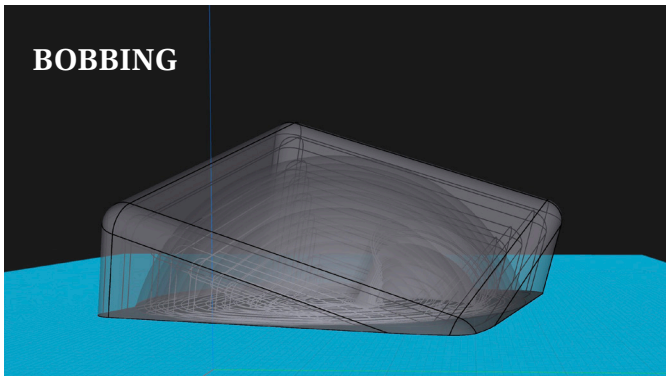
schema video of experience 'popping'). So when we look for correlates and mechanisms, these are features to keep in the forefront of our minds!

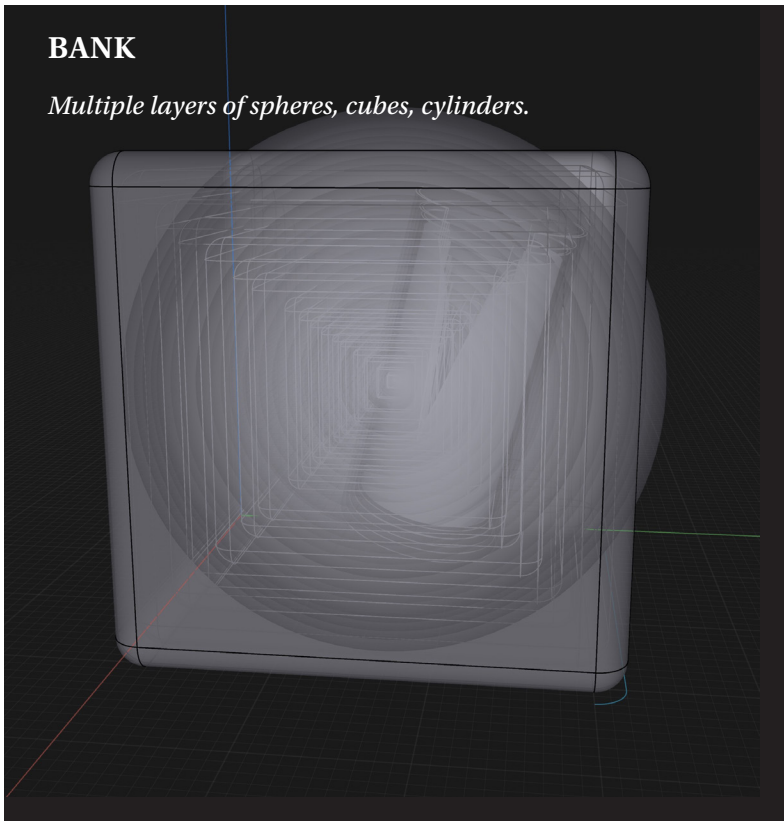
Of course, I should emphasize here that although the schemas are 3D videos, it is at the tracer progressing along ring paths (or frame instantiations) through the 3D perceptual realm where qualia are felt. Felt qualia are shifts in location of the tracer/rings/frames/bank 'printhead.'




And speaking of the 'bank,' here are some depictions from my first iteration of this book, showing a quite weird phenomenon of how the bank appears to bob like a cork in water, with some fast, but short jostles; some slow, but large alterations in tilt; and some quite slow ebb and flow of the 'water level' (may be another bank, and the interaction of the two may select rings off the grey copy [grey depicted here, actually colorless]). I've only observed this phenomenon once, in the deepest stage of nmda-antagonism, relaxed, eyes closed. The 'broken glass' is one object playing prominently in my 'bank,' but it also appears to be a region for hands, tools, phones, etc. On rare occasion, the bank may 'leak' enough to reveal that the glass continues downward into a 'leg' below the bank, and there is a pyramid 'hat' over the top. All shapes seem to be stored by it.

I think, by now, an undeniable realization arises that consciousness (and even the autopilot/reflex system) is a profoundly unified construction. It is some kind of agreement and set of rules whereby a multicellular collection can act as a single entity.

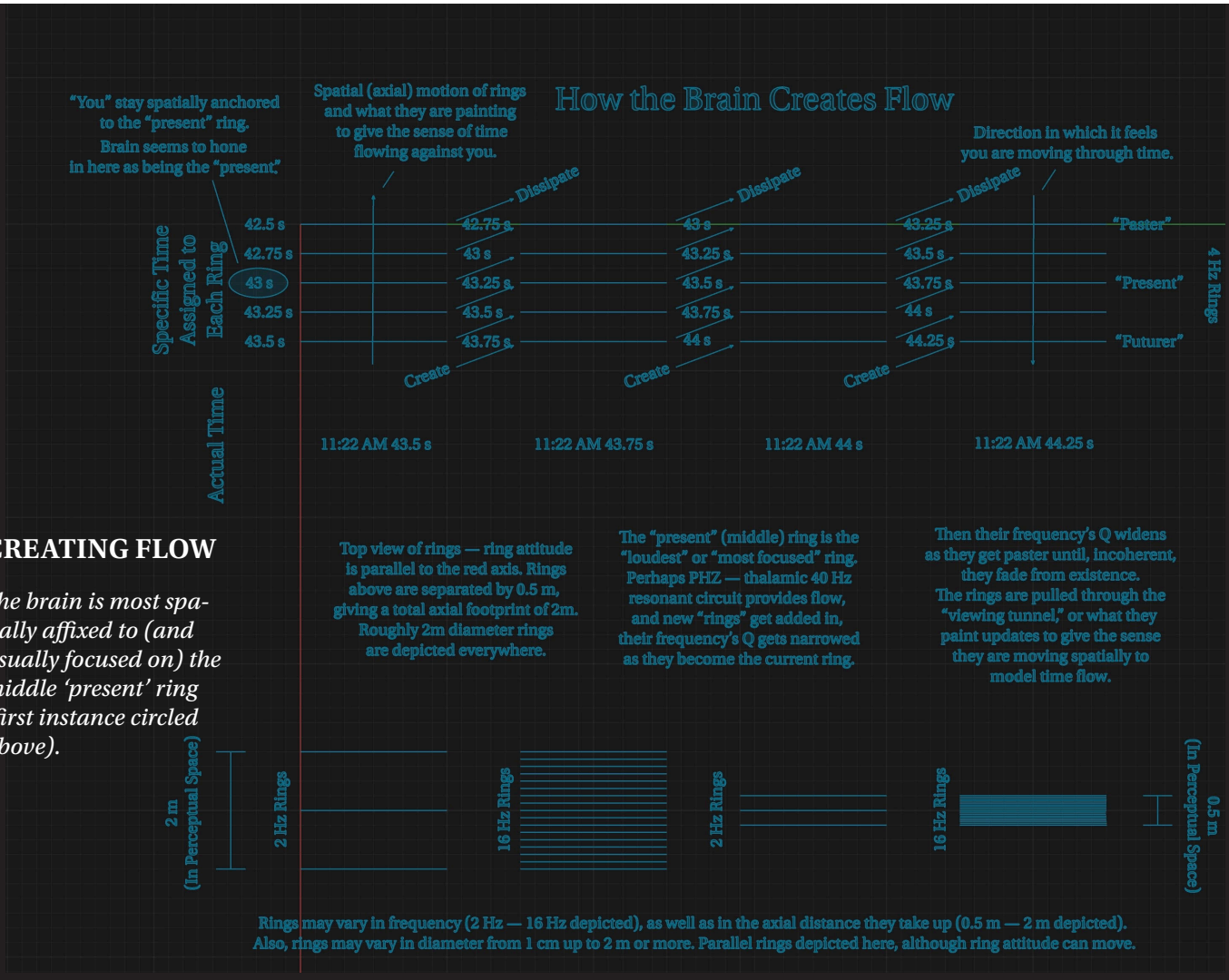


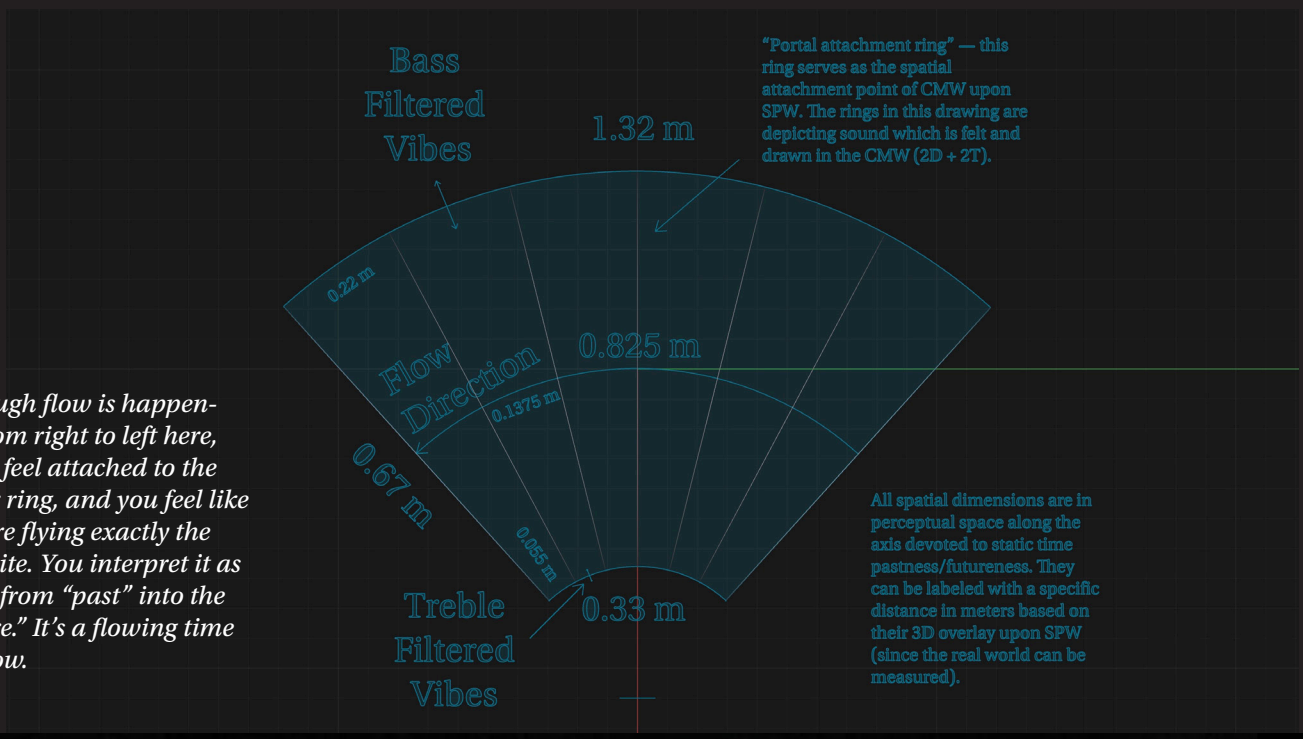



Computations straddling multiple cells and multiple deciseconds of time are seemingly imbued with mechanisms to act in the interest of the drawn avatar and scenarios. Let's look at some depictions of ***(IV) unity of time flow***. I argue that felt qualia are due to ring modulation in this fusing schema.

As I've said before, working memory is depicted in the fusing schema as (often) an axis of space. Since rings linking the 3D schemas are themselves only 1D (and only take up a 2D plane, usually), the extra axial dimension is used to dedicate regions of positive offset to + 0-0.5 seconds 'future' and regions of negative offset to – 0-0.5 seconds 'past,' with the 'present' the most focal center and the region of actual fusing. This way, predictions can be made, one second can be held in memory, and felt qualia can arise as ring-modulations there.

Even a simple vowel like 'i' relies upon working memory to observe the behavior of two formants above the root changing direction in a certain






*Although flow is happening from right to left here, "you" feel attached to the center ring, and you feel like you are flying exactly the opposite. You interpret it as going from "past" into the "future." It's a flowing time window.*

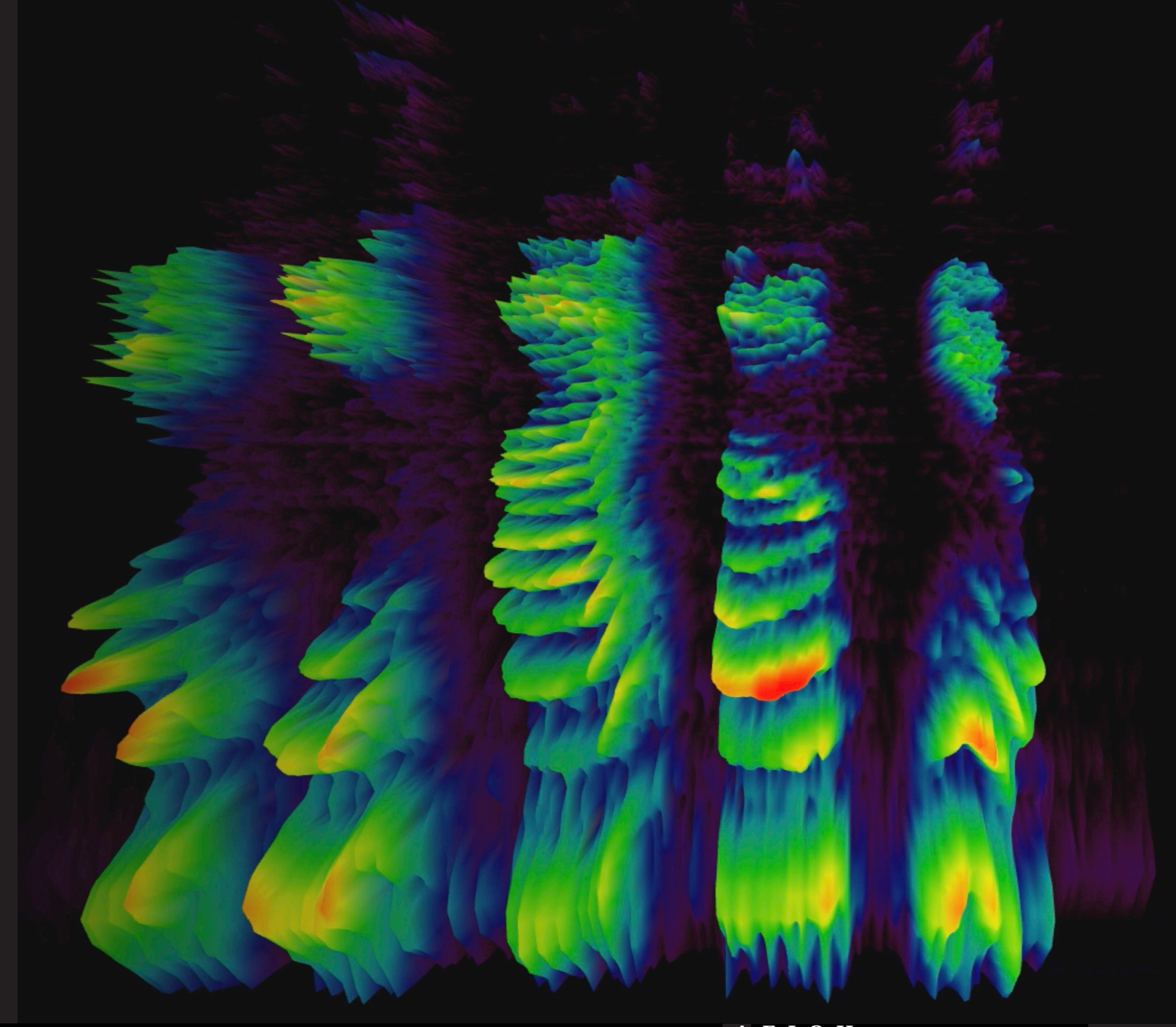
## PROPOSED MECHANISM OF SOUND SEGREGATION AND QUALIA FEEL

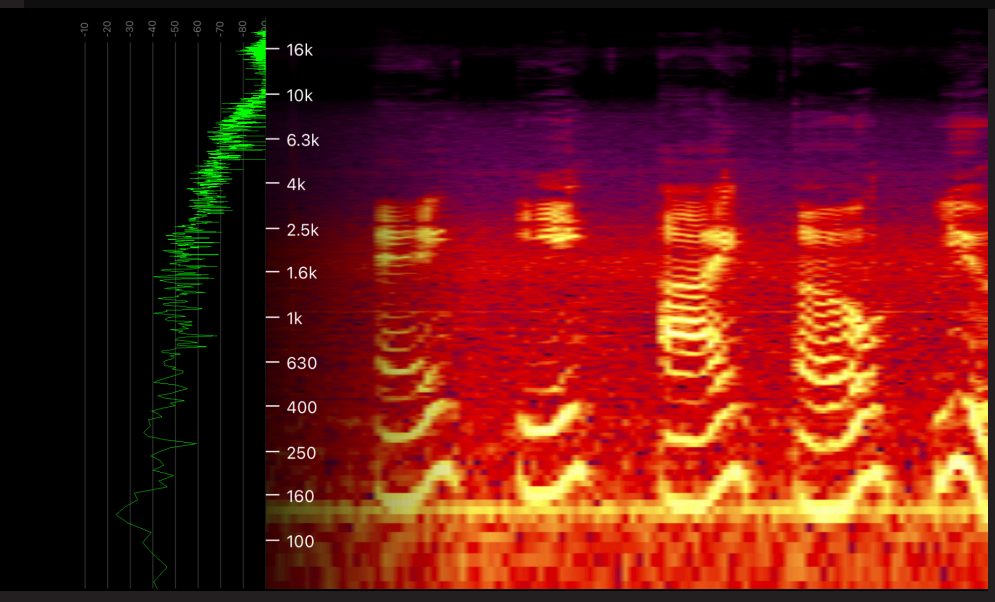
*Coming back to "vibes," (the conveyance and feeling of sound) the following is proposed for how the brain is able to isolate the human vocal part of a song from the bass guitar (etc.), and map each component to its correct source (talking only identification here, not placing of audio within the space of the real world—a job best handled by SPW—Sensory Physical World i.e. real world schema).*

*Top: Let's say you have a flow window that measures 0.67 meters in diameter by 0.825 meters long (in perceptual, CMW [Cartoon Motor World, i.e., imagination schema] space). Now let's say you begin playing your favorite song fairly loudly. Mental imagery (even if subconscious) kicks into gear immediately, dropping whatever it was drawing (probably enlarged mental imagery of you pushing the play button) to now model the main sounds of import. Half-way into the song, with vocal and bass going loud, the flow window may look like the above image. The bottom part (in this top-down view) of the rings are getting compressed, while the top part of the rings are getting rarefacted. But remember it's a top down view, so really it's the right side of the (say, coronal) rings (with your mind's eye located at the crease of this book looking towards the center ring) where the singer's mouth is that is getting compressed spatially, and the left side of the rings where the bass guitar is that is getting rarefacted.*

*By compressing part of the rings axially, you get more rings per second—more dampening or exciting nodes if you will—making it harder for big wavelengths like bass to find a home there. Essentially, you've made a high-pass filter that encourages only higher tones to experience resonance in the given distance allotment and which deadens the big wavelengths. And the vibrations seem to be of the cave walls/ceilings (radially in and out), between rings; or of the rings themselves (radial vibration). But is the dog wagging the tail or the tail wagging the dog? It may be that this isn't a filter at all, but is just a way of conveying the segregation of parts to the prefrontal cortex.*

*This is obviously unsatisfactorily imprecise, and unfortunately I haven't observed enough to distill it into an entirely consistent explanation. I suppose for now it is best to say that sound seems to do something to the rings, or the region between rings—whether this is geometrical up/down vibration of a line, radial amplitude modulation of rings (like a filter-Hilbert envelope), a frequency modulation of rings, a speed modulation of the flow at various phases of the rings and at various times, etc.!*

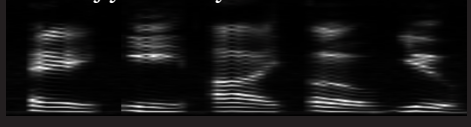





## A, E, I, O, U

*These images are plotting frequency over time of the sound of 'a, e, i, o, u,' with the top image captured with Chrome Music Lab (made by Jeramy Morrill and Boris Smus; https://musiclab.chromeexperiments.com/spectrogram/).*

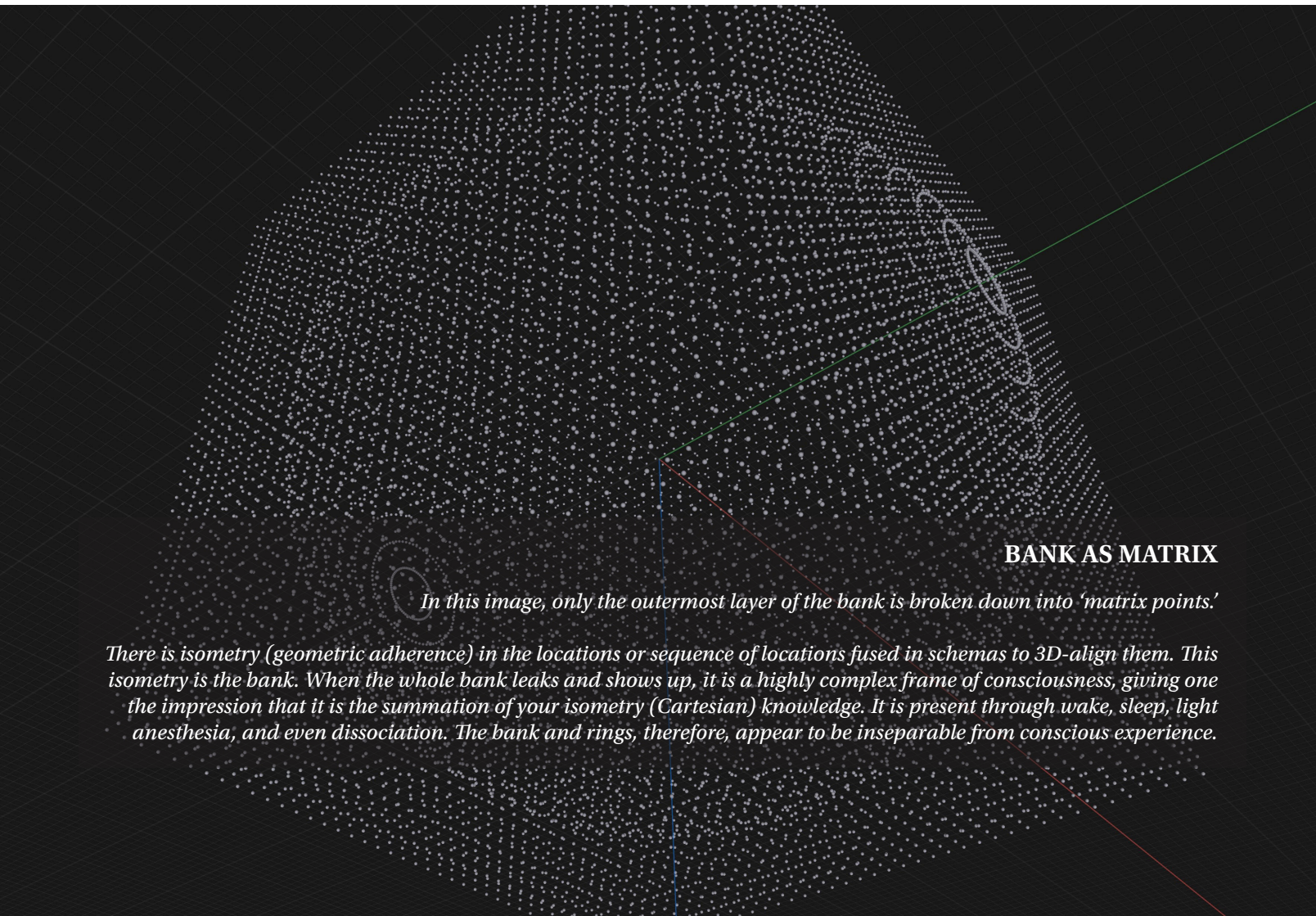
*Lower right: The fundamental is at the bottom; the formant structure (overtones) of the middle letter 'i' is a diphthong ('ahh' + 'eee')—pay attention and you can hear a middle formant ascend while a higher one descends if you slowly vocalize the vowel.*



way—in other words, the vowel 'i' cannot exist in 50 ms. You need roughly 250 ms of time to see two simultaneous patterns of changing frequency in a multitone input to have a neural match to 'i.' This repeats the crazy observation that consciousness rides atop multiple moments of time to perform its identification and other processes.

And, as Clive Wearing shows, consciousness relies on medium and long term memory for ***(V) time span unity.*** Without it, the future you will continually get siloed off from the past you.

One can visualize the bank I talk about as being a 3D Etch-a-Sketch with millions or billions of mappable voxel points. Unfortunately, I haven't yet found a sufficiently promising neural correlate of the bank, but it's possible that it involves the ventral visual stream, greater hippocampal area, prefrontal cortex, and possibly fine-tuning (in time and space) from the cerebellum's input to the cerebrum. But, to wrap up this chapter on the binding problem, although rings are the profound unifier, they are taken from off (and recorded onto) the bank structure. If we want to understand consciousness, and really conquer the binding problem, I feel we must identify the neural correlate and mechanism behind this bank structure.



**BANK AS MATRIX**

*In this image, only the outermost layer of the bank is broken down into 'matrix points.'*

*There is isometry (geometric adherence) in the locations or sequence of locations fused in schemas to 3D-align them. This isometry is the bank. When the whole bank leaks and shows up, it is a highly complex frame of consciousness, giving one the impression that it is the summation of your isometry (Cartesian) knowledge. It is present through wake, sleep, light anesthesia, and even dissociation. The bank and rings, therefore, appear to be inseparable from conscious experience.*

# 3

# *The Spatial Problem*

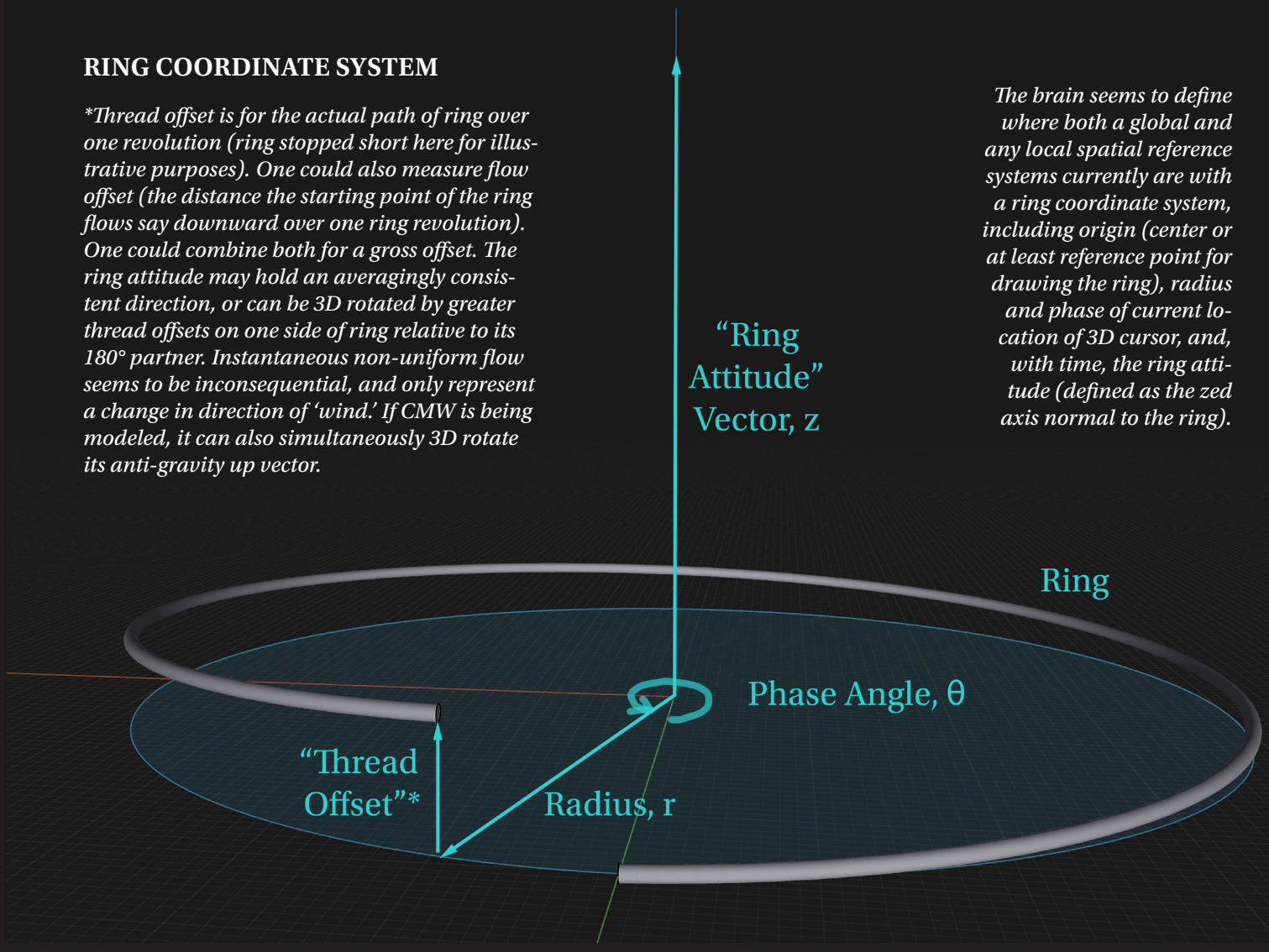
*How the brain constructs spatial pictures remains a deep dark mystery.*
*— Steven Lehar, Cartoon Epistemology (2003)*

I'VE ALREADY described how I think consciousness is drawn, and how it solves the binding problem, but there's another problem that never gets discussed — *the spatial problem*. Every single aspect of consciousness aforementioned must dwell in a 3D spatial environment — every perfectly square cardboard box you experience must be drawn and felt in a 3D way. How does a

**RING COORDINATE SYSTEM**

**Thread offset is for the actual path of ring over one revolution (ring stopped short here for illustrative purposes). One could also measure flow offset (the distance the starting point of the ring flows say downward over one ring revolution). One could combine both for a gross offset. The ring attitude may hold an averagingly consistent direction, or can be 3D rotated by greater thread offsets on one side of ring relative to its 180° partner. Instantaneous non-uniform flow seems to be inconsequential, and only represent a change in direction of 'wind.' If CMW is being modeled, it can also simultaneously 3D rotate its anti-gravity up vector.*

*The brain seems to define where both a global and any local spatial reference systems currently are with a ring coordinate system, including origin (center or at least reference point for drawing the ring), radius and phase of current location of 3D cursor, and, with time, the ring attitude (defined as the zed axis normal to the ring).*

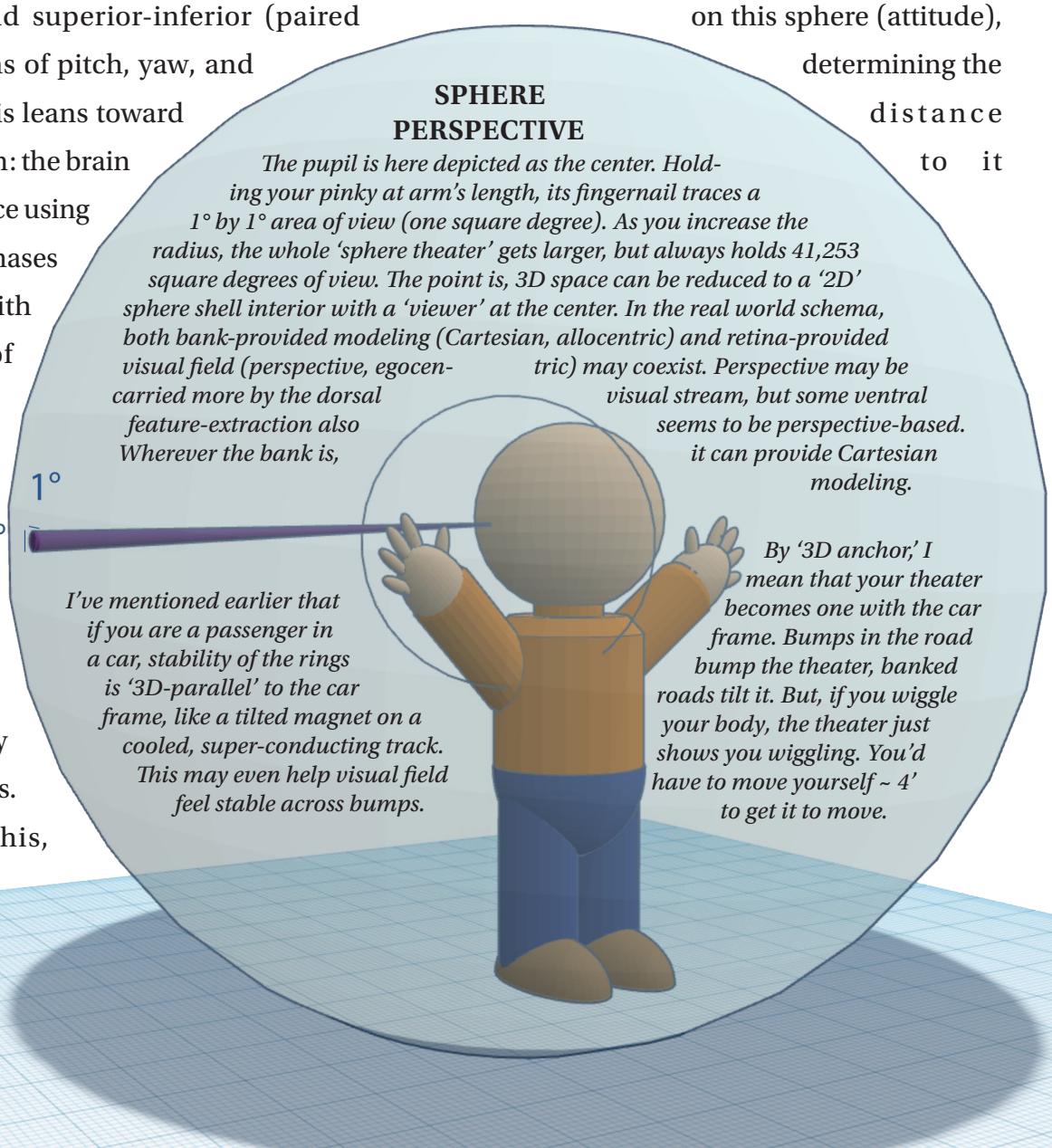


cortical surface that is anything but planar represent things like boxes, walls, cars, animals?

This is the spatial problem, and it's a formidable one—arguably the most challenging aspect of consciousness. There are theories, yes, but the problem is persistently elusive.

In scientific circles, space is typically navigated using the Cartesian coordinates: x, y, and z. Neuroscientists, conversely, might refer to anatomical directions and rotations like anterior-posterior, lateral-medial, and superior-inferior (paired with head rotations of pitch, yaw, and roll). My hypothesis leans toward a different approach: the brain might conceive space using origins, radii, and phases of circles, along with the orientation of these rings in 3D space—somewhat akin to polar or spherical coordinates but with the added twist of allowing the polar plane to rotate freely in three dimensions.

To visualize this, imagine space as a sphere surrounding you, with you at the center — akin to a panoramic view of the world from a chameleon's perspective, though less comprehensive. Extend your pinky at arm's length; the nail represents approximately one square degree. If you could rotate this one degree segment to cover every point on a spherical shell, you'd map out the entirety of your visual field. Now, picture this sphere's inner surface displaying a panoramic photo of your environment, with you at the center, looking out. Your spatial understanding in this model would involve selecting a point on this sphere (attitude), determining the distance to it



(radius), and interpreting object sizes to gauge their distance, much like interpreting a photograph.

**Ring Coordinate System**

In visualizing the process of forming a ring, imagine a tracer beginning at a starting point, designated as phase $\theta = 0^o$, and tracing a path in a circular motion. As it progresses, the phase increases, completing a full cycle when it reaches $\theta = 360^o$. The tracer can vary the radius dynamically, which might result in an irregular 'squiggle' rather than a perfect circle. The orientation of the ring—its 'attitude'—remains perpendicular to the plane in which it lies.

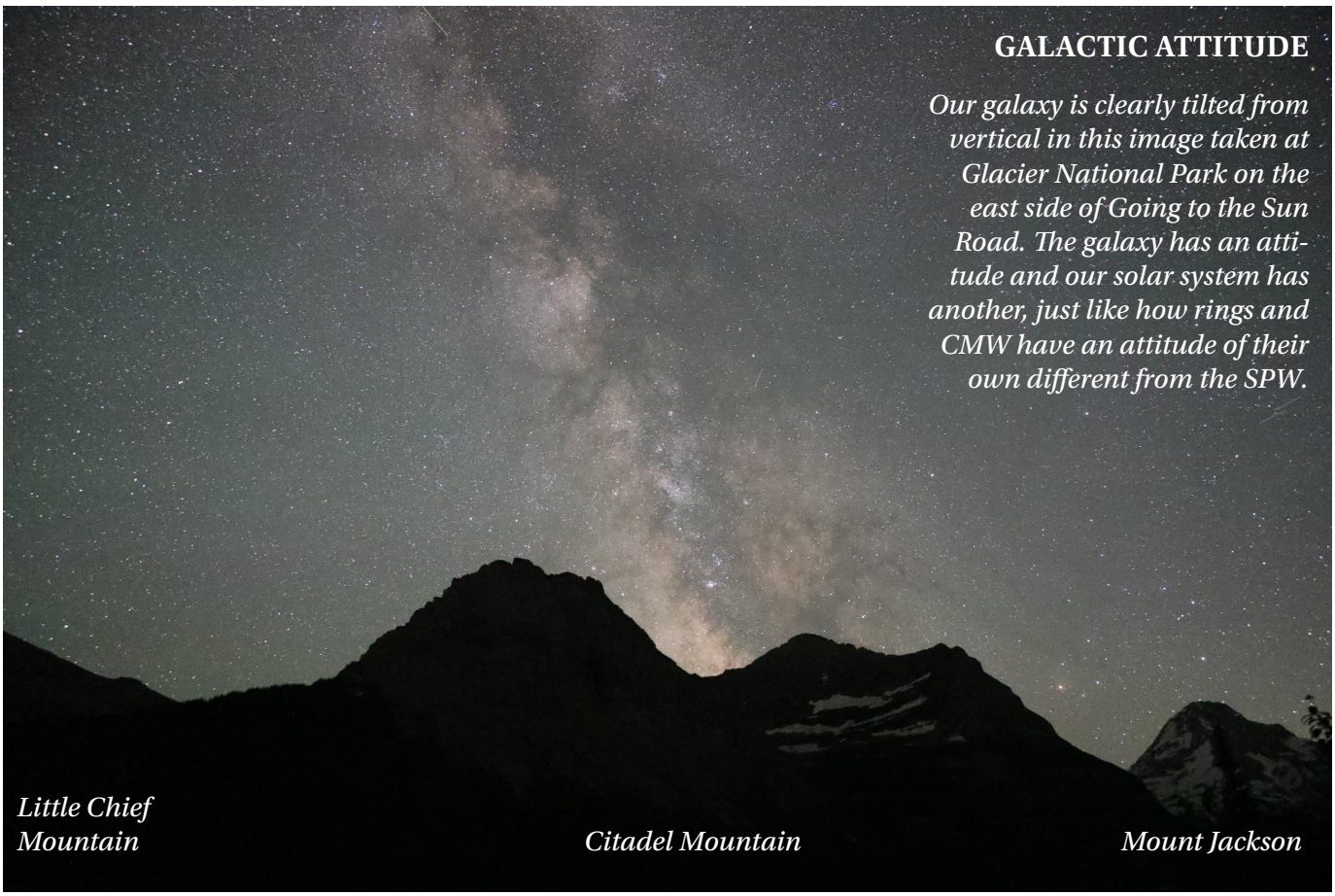
However, this may not fully capture the brain's method. Envision the 'bank' as a foundational structure from which rings emanate. Though rings are usually what is used, the rest of the bank is still attached—it just isn't currently leaking out to reveal itself. The brain defines a path for these rings within the bank, incorporating phase changes, radius variations, and ring orientation seamlessly. Additionally, the bank has its own orientation, known as the 'bank crown up' direction, and is synchronized to a specific phase.

This bank serves as an anchor point, a reference

for other schemas like the real world and imagination, each with its Cartesian coordinates and internal spatial relationships. A central 'fusing schema' seems to act as a constant, maintaining its orientation and phase alignment throughout life's experiences. Even the concept of perspective—our viewpoint—is modeled as a three-dimensional construct impinging on a 3D copy of the bank centered around the viewer's pupil.

It's important to recognize that while the overall schema representing the real world may be relatively static, certain elements within it are not; your avatar, your car, and other objects are in motion. By contrast, the imagination schema is far more dynamic, undergoing constant changes in scale, orientation, and position. The 'bank' is the pivotal point where these dynamic spatial relationships are resolved within the unchanging frame of the fusing schema.

If the brain uses rings (correlating at all to LFP brain waves?), frequency and angular velocity are measuring the same thing, just at a grosser and finer scale of temporal resolution, respectively. Frequency is like a video editor that samples once per ring; the sky is the limit with angular velocity —it takes essentially an infinity of samples both




**GALACTIC ATTITUDE**

*Our galaxy is clearly tilted from vertical in this image taken at Glacier National Park on the east side of Going to the Sun Road. The galaxy has an attitude and our solar system has another, just like how rings and CMW have an attitude of their own different from the SPW.*

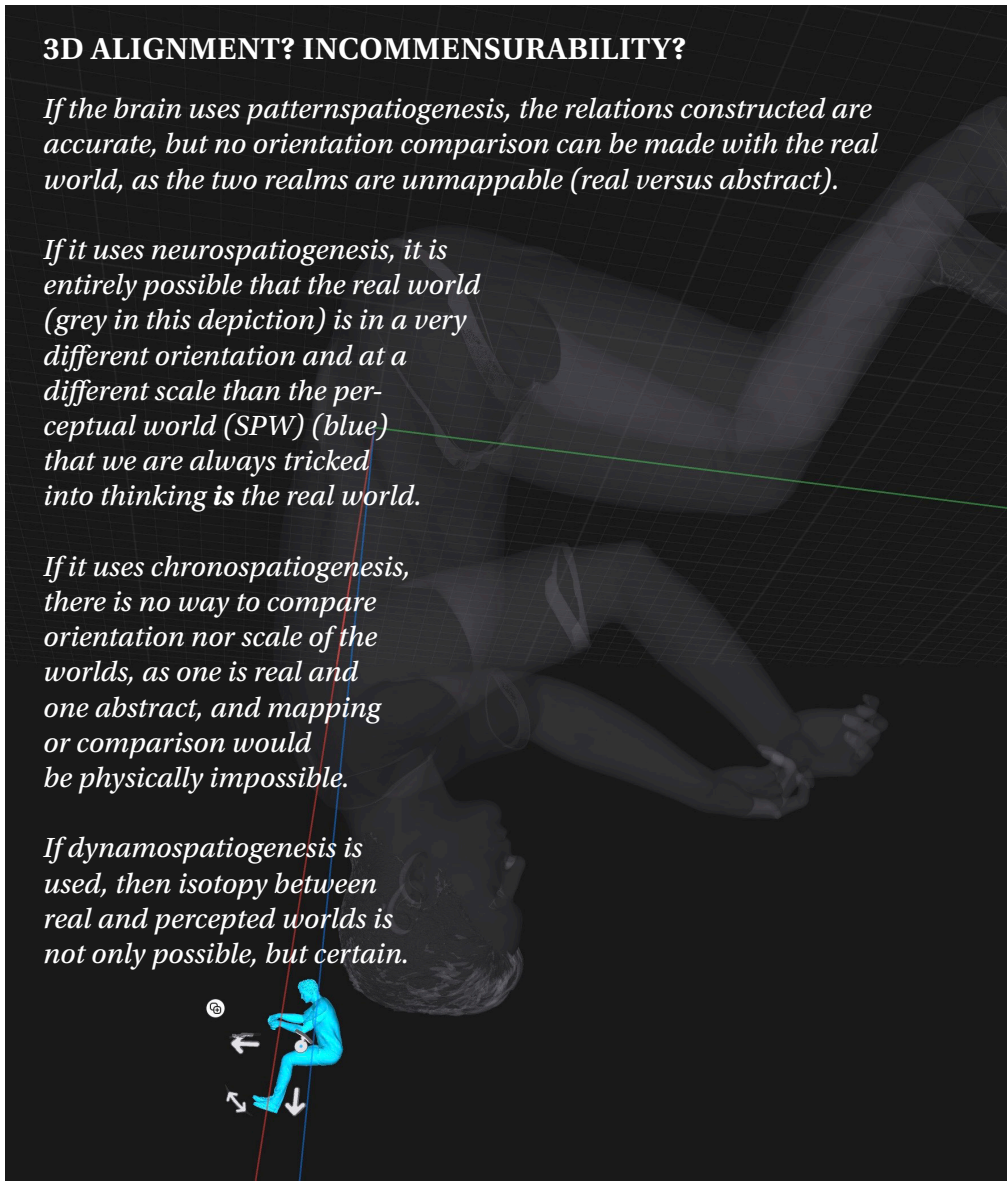
| Problem | Description |
|---|---|
| Representation Problem | How does the brain encode and represent external physical space internally, and what internal coordinate system does it use? Such a meaning space would by definition be incommensurable or incomparable with the orientation, scale, and position of the physical reality. |
| Conscious Integration Problem | How does the emergent consciousness—from neural ensembles, resonance, or switching—integrate and influence attention and response in perceptual space (with avatar response mapped to physical body response)? |

per second and per ring. As such, angular velocity would be a better way to measure the exact (to millisecond precision) speed of the tracer, but that would require understanding the mechanism of ring-drawing.

The table above delineates two primary spatial challenges. The first can be described phenomenologically, though a definitive neural mechanism remains unverified. Phenomenologically, the brain's ***1. spatial representation*** is anchored in the Cartesian coordinates of the 'bank,' providing a three-dimensional framework to the real-world and imagination schemas. This bank serves as the 'printhead,' with connections to content at each voxel acting as 'ink nozzles.' While the real-world schema is fairly static, the bank and the imagination schema are dynamic, undergoing '3D rotations.' These schemas' 3D alignment is continually refreshed by a tracer following ring trajectories within the comprehensive fusing schema, which also encapsulates the working memory's one-second flowing time window. The exploration of potential neural mechanisms underpinning these processes is reserved for later discussion in this book.

But, ***2. conscious integration*** represents a distinct aspect of the 'spatial problem.' Identifying a neural mechanism for this remains elusive, yet insights can be gleaned from Kevin Mitchell's recent book on 'free agents.'[10] Mitchell elucidates the adaptive behavior of E. coli, detailing the role of FNR, the master transcriptional regulator that enables the bacterium to toggle between aerobic and anaerobic metabolism. This switching is contingent upon the FNR protein's ability to sense and respond to the presence of oxygen, illustrating a sophisticated biological adaptation to environmental changes. Mitchell suggests that humans possess intricate systems that enable our motor actions to align with flexible goals, informed

10 Mitchell, K. J. (2024). Free agents: How evolution gave us free will. Princeton University Press.




by incoming sensory data. We effortlessly adapt our movements to fulfill our intentions, guided by perception and the nuanced 'feltguage' of ring sensations. Pinpointing the exact neural processes that facilitate this remains a complex endeavor.

In my book's first release, I was still exploring theories of how the brain makes representational space: ***(1) 'pattern-spatio-genesis'*** meant coding individual aspects as dimensions in Fourier space, and/or encoding the voxel points constituting the bank via unique ensembles of neurons in the prefrontal cortex; ***(2) 'neuro-spatio-genesis'*** meant that the brain—or some part—was the bank, with the layout of neurons looking like the bank; ***(3) 'chrono-spatio-genesis'*** meant there is never any instantaneous understanding of multiple locations and that time alone could be used to reach various points along rings in rapid cycling; ***(4) 'dynamo-spatio-genesis,'*** utterly unscientific, meant the perceptual body below you was in the same location as the physical one, with representational space mapping to its 'felt' movements (phantom pain & no consciousness of movements under anesthesia defeat this poor theory). I'm still exploring, but I've pretty much ruled out the latter three (leaving only 'pattern-spatio-genesis' or something else)—I ruled out number two because I can't find the bank shape anywhere in the brain; number three, because there are instantaneous frames of entire point clouds at times (requires full bank understanding); and number four, because it's stupid as I already explained.

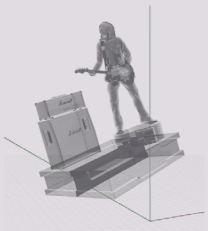
In exploring the neural mechanisms underlying our internal, representational space (i.e., conscious experience), let's first revisit our phenomenological observations. Consider the 'selective attention' illusion exemplified by the renowned experiment involving a basketball game video.[11] You're tasked with counting the passes made by players in white shirts. Amid this task, a gorilla saunters through the scene. Initially, this gorilla might evade your notice entirely. However, once you're alerted to its presence, your focus shifts, making it nearly impossible to overlook the gorilla from then on.!

This experiment underscores a prevalent misconception: the idea that our brain continuously constructs a comprehensive 3D model of our body and our environment. Instead, I suggest a model of selective 3D attention, akin to the gorilla scenario, but extended into three dimensions. The original gorilla example functions within a 2D frame, where our attention shifts following our eye saccades, mainly following the ball. In contrast, our 3D perceptual experience involves a more nuanced form of attention. We typically focus explicit 3D modeling on one specific element at a time, similar to how our attention in the 2D video gets drawn to the gorilla once we're aware of it. This selective attention plays a key role in how we perceive and interact with our three-dimensional world. This phenomenon can be likened to a form of three-dimensional saccade. While literal eye saccades can prompt the 'bank' to shift in 3D towards an object of attention, it's often the case that incoming signals of postural adjustment from the body instigate this movement. These signals can direct the 'bank' to model various elements, such as a person in our periphery: even if we don't turn our gaze towards this person, the 'bank' momentarily shifts there to construct a model of them.

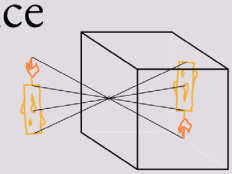
In the lower figure (facing page), one second of experience is depicted, with two frames on the phone, two frames of transition (not shown), two frames on the girl's postural adjustment, two frames of transition (not shown), and two final frames back on the phone. These sequences represent what we might term 'bank saccades,' a process that segments our conscious, geometric understanding into discrete moments. The frames produced by this 'bank' appear to be modulated—perhaps in amplitude, frequency, or some other factor—at a rapid rate (possibly ranging from 5 to 1000 Hz), creating the sensation of all felt qualia.

The 'bank' could potentially reside in the prefrontal cortex, perhaps involving the ventral visual stream, or it might function within the thalamo-cortical resonance system. This mechanism might be further refined by the interplay between

11 Daniel Simons: YouTube. (2010). selective attention test. YouTube. Retrieved November 9, 2023, from https://www.youtube.com/watch?v=vJG698U2Mvo&t=46s.

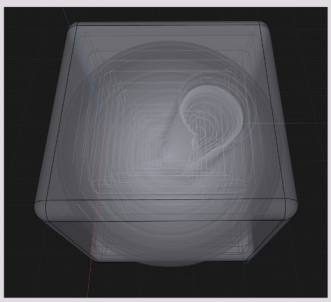


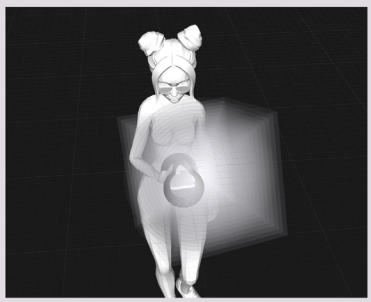
# Most Fundamental Division of Conscious Experience



## Context (2-12++ Hz)
## Isometric Shape

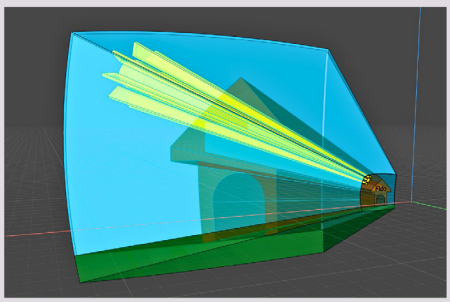
- Provides isometric understanding of 2D/3D outlines/surfaces. By storing shapes to a "3D Etch-a-Sketch" bank, they escape warp from perspective visual field. It is accurate understanding of shape apart from any viewer's vantage. Also carries feeling of qualia.

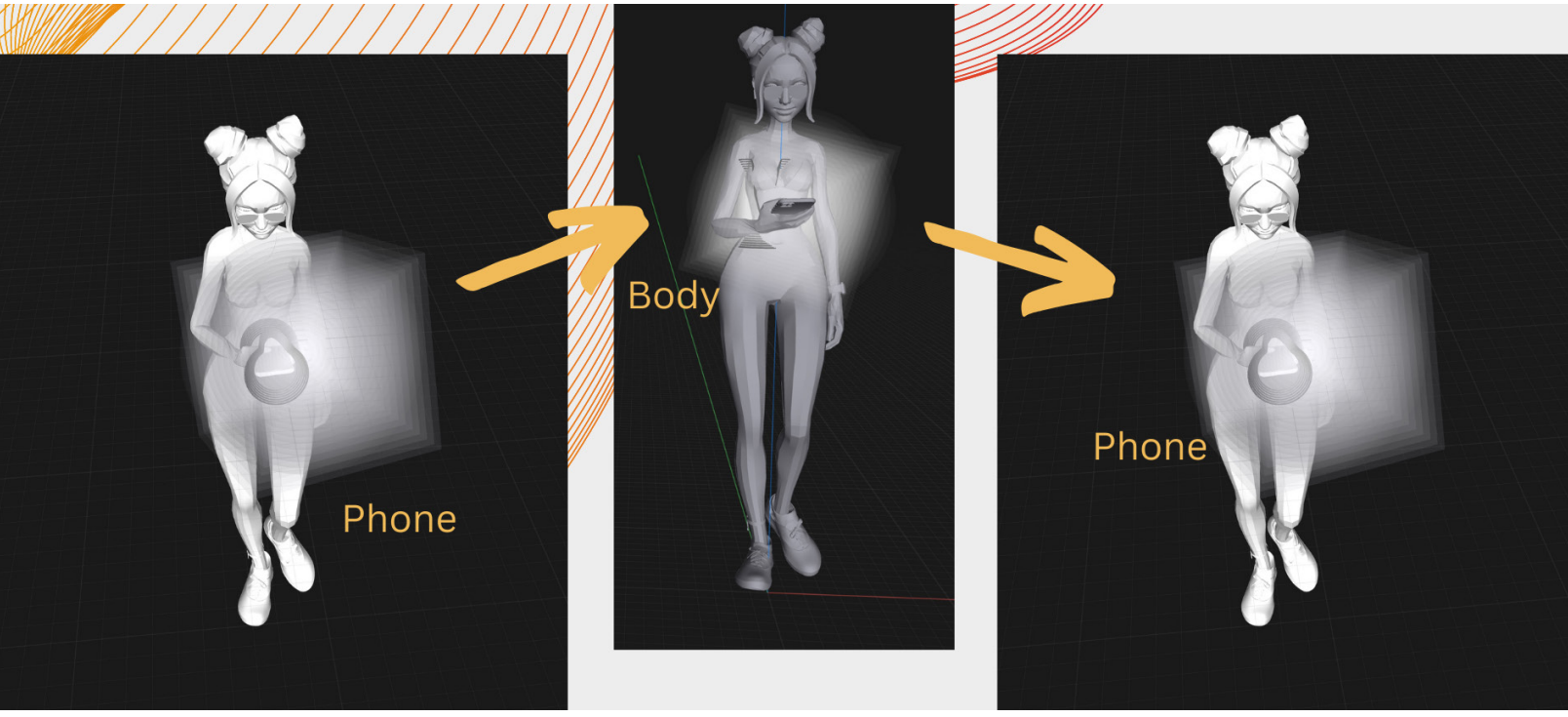




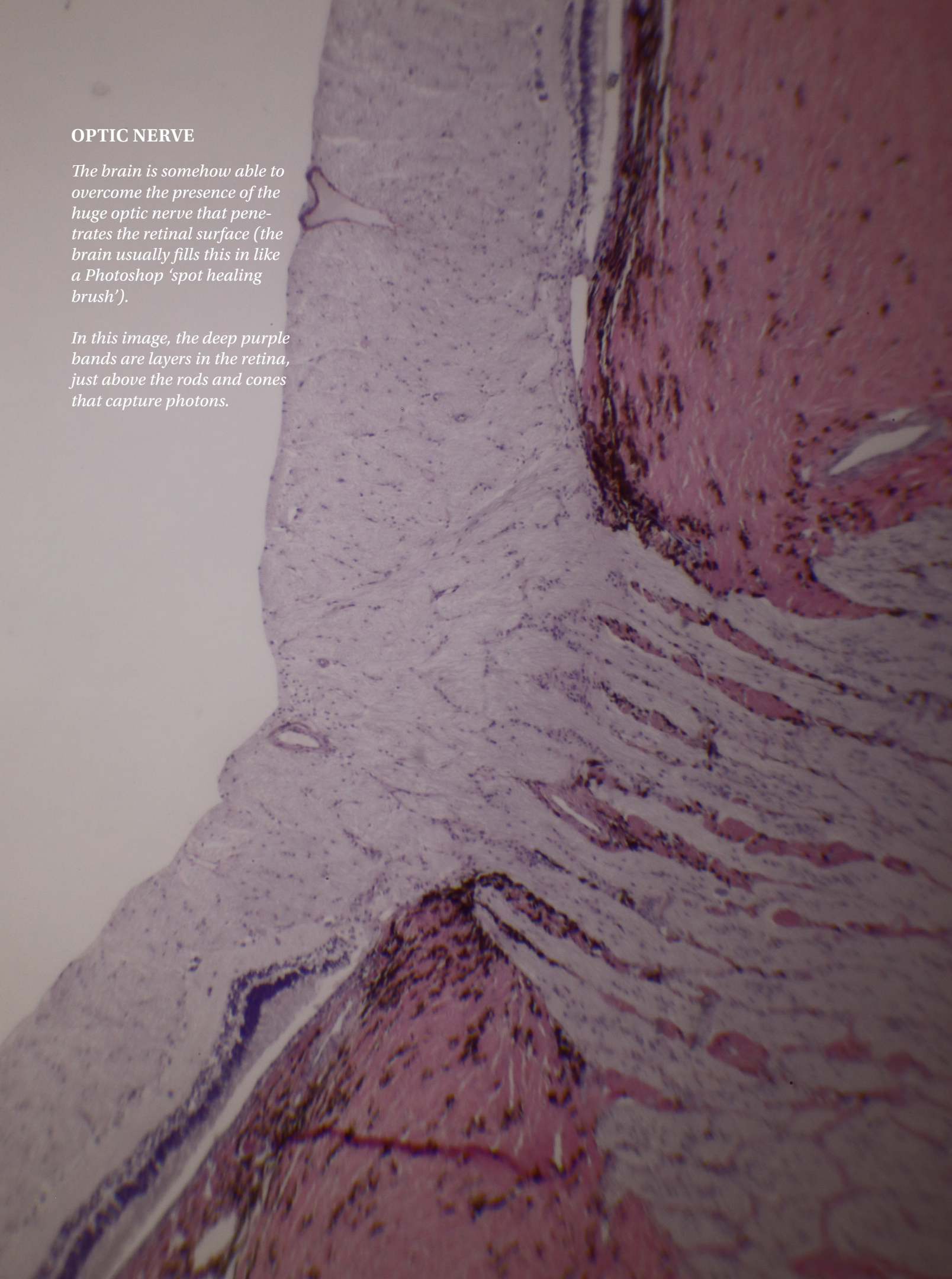
## Content (40-80+ Hz)
## Theta-Phi Visual Field

- Provides a 0D 'star cluster' composed of 3D vectors oriented at the pupil and extending outward towards their points of origin. Each vector equals a (usually colored) pixel.





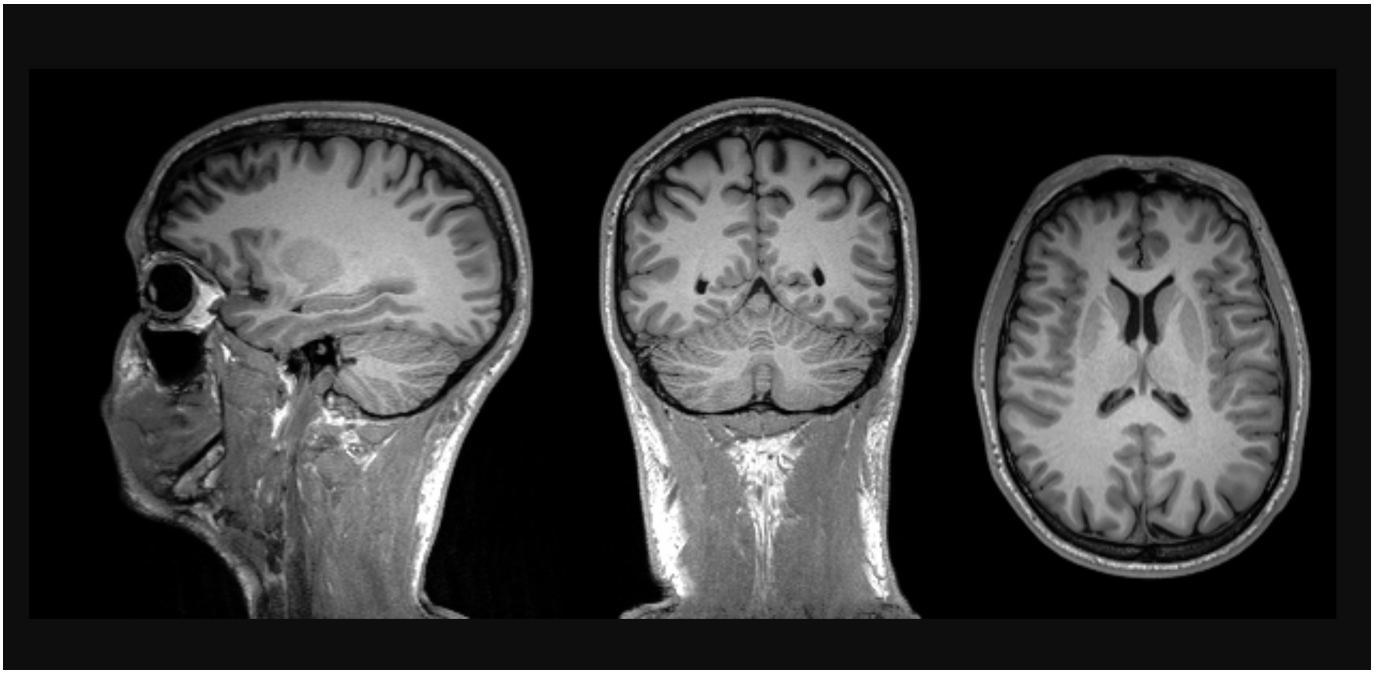

the cerebellum and cerebrum. It's conceivable that various regions of the cortex are assigned specific categories, enabling them to 'attract the bank'—in other words, to capture the attention or focus of the prefrontal cortex. Perhaps these specialized regions of the brain become adept at 'anchoring' their specific features—such as a face, a letter, or an object—to the 'bank,' thereby facilitating the process of recognizing similarities. Indeed, functional MRI (fMRI) studies corroborate this,



## OPTIC NERVE

*The brain is somehow able to overcome the presence of the huge optic nerve that penetrates the retinal surface (the brain usually fills this in like a Photoshop 'spot healing brush').*

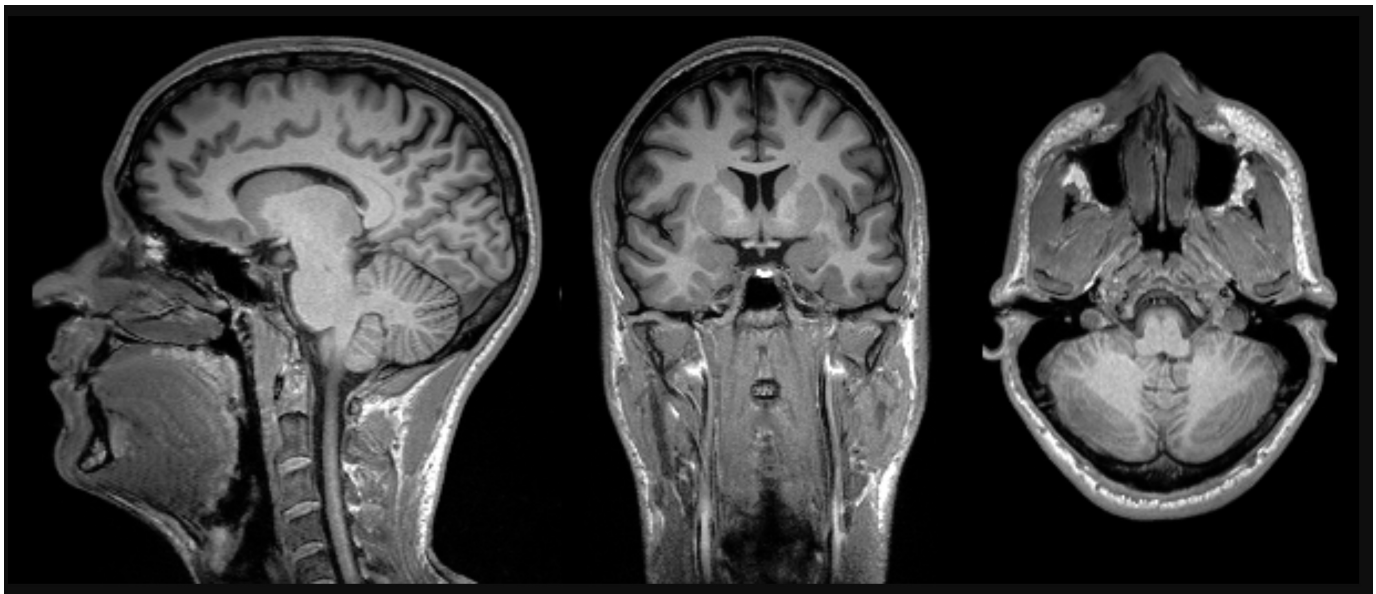
*In this image, the deep purple bands are layers in the retina, just above the rods and cones that capture photons.*



showing activation in these 'island' regions during tasks like face, letter, object, or scene recognition. Interestingly, lesions in these areas don't result in a complete loss of the 'bank,' mental imagery, or 3D understanding. Instead, they specifically impair such processing related to the category associated with the damaged region.

Grid and place cells are often mentioned as potential correlates when discussing the 'bank.' While it's possible, they appear more involved in aligning an avatar with the environment, especially in low-light conditions. Moreover, individuals with hippocampal lesions or surgeries still seem capable of navigating immediate 3D space.

The images shown above and below illustrate sagittal, coronal, and horizontal plane MRI scans. MRI machines, such as the 3-Tesla version used here, utilize magnetic methods to safely capture brain images. 7-Tesla MRI systems can provide even more detailed imaging than displayed here.



# 4

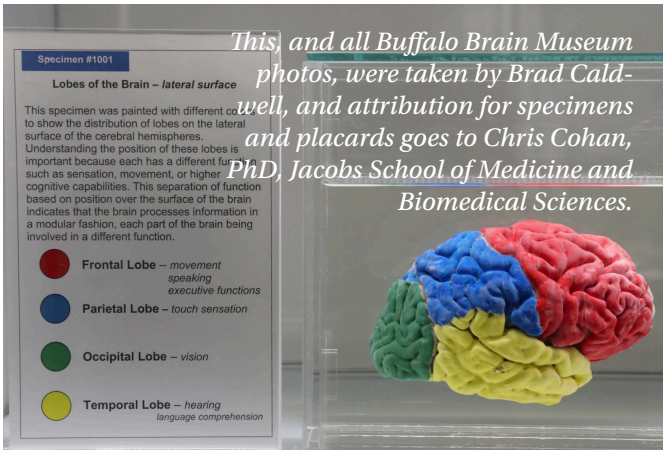
# *Brain Circuitry — Macro Scale*

*Each of us lives within the universe...of his own brain. Projecting from it are millions of fragile sensory nerve fibers, in groups uniquely adapted to sample the energetic states of the world around us: heat, light, force, and chemical composition. That is all we ever know of it directly; all else is logical inference.—Vernon Mountcastle*

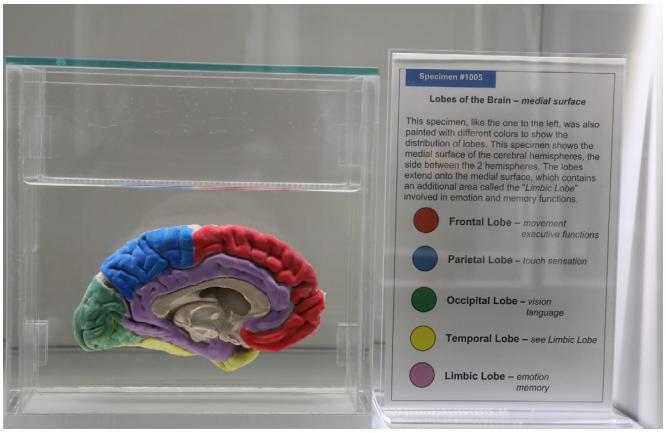
Let's talk general brain structures and their possible functions under this theory.

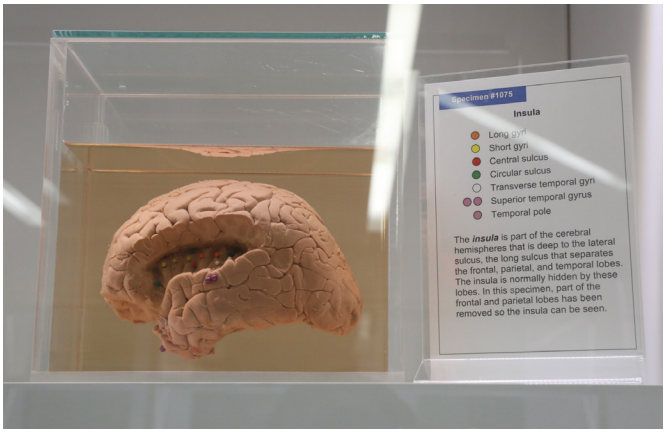
### Cerebrum

The cerebral cortex is the outer layer (about 2 mm thick) of an agglomeration of cell bodies in a regular, columnar layout. In these images taken at the Buffalo Brain Museum, you can see the frontal, parietal, occipital, temporal, and limbic lobes highlighted in red, blue, green, yellow, and purple, respectively; they handle motor/focus, body, vision, sound, and meaning/mood/likeness

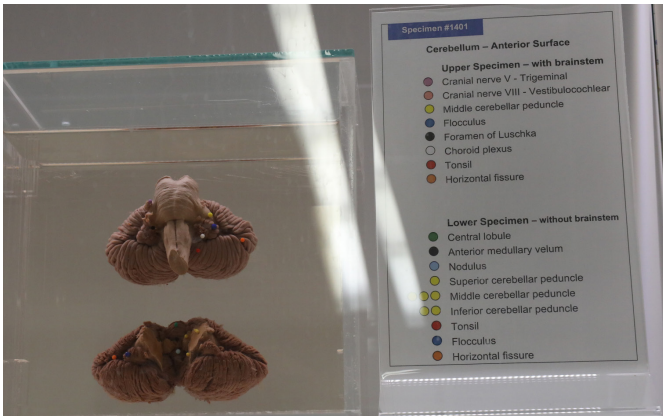


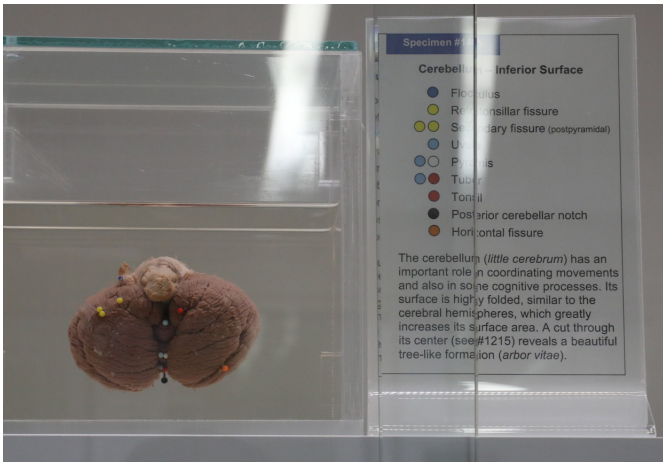

*This, and all Buffalo Brain Museum photos, were taken by Brad Caldwell, and attribution for specimens and placards goes to Chris Cohan, PhD, Jacobs School of Medicine and Biomedical Sciences.*

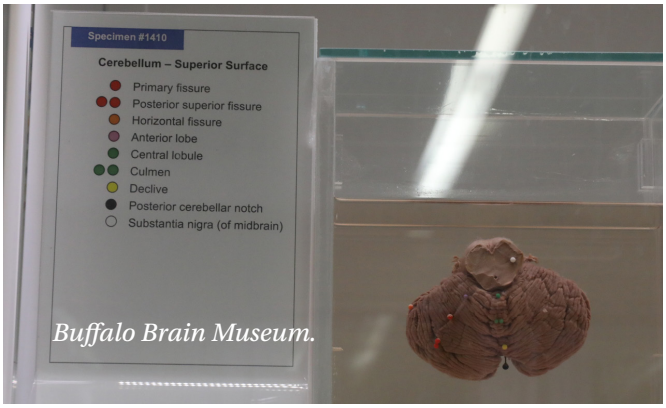


tables/familiarity respectively. The front half has only the frontal lobe, and seems responsible for the CMW. The back half includes occipital, temporal, and parietal, and seems responsible for the SPW. Perhaps the limbic lobe with the insula (depicted below) handles mood and body internals as part of a BPW (Body Proprioception World). This world almost feels like a hybrid between SPW and CMW, taking some aspects from each, yet making a unique, but not easily detected, world. Anyway, *the cerebrum has a few major loops*: cerebellum, basal ganglia/thalamus/brainstem, and hippocampus/amygdala.




*Buffalo Brain Museum.*

### Cerebellum

I think the cerebellum is probably a sort of 3D video card—enabling order of magnitude better resolution and accuracy in mapping of all incoming stimuli to their exact, actual position in representational space. But it's probably just the *calculations* for arriving at the right answer in some sort of neural language, not any literal placing in the right spatial spot. I think internal and external imagery, and even rings, are assisted by the cerebellum.

The cerebellum may be providing this high-resolution 3D mapping info for the prefrontal cortex as it draws cartoon outlines constantly. Certainly it provides spatial acuity for body skins and movements (but movements are just a series of stills), and it might help align CMW skins to SPW objects. The cerebellum also gets audio input—from the cochlear nuclei, the inferior colliculi, and auditory-related parts of the cerebral cortex. This might be needful for the prefrontal cortex to draw/align imagery representations of songs or sounds heard.

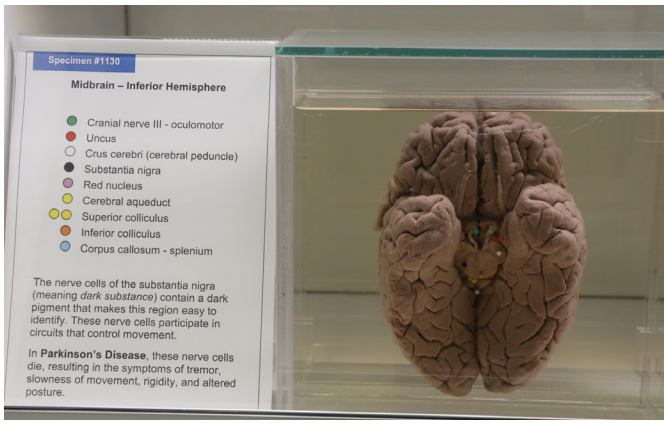
## Basal Ganglia

Located near the thalami, but slightly forward, the basal ganglia play a crucial role in regulating actions and thoughts before they are fully executed. This involves a process where impulses pass from the cortex to the basal ganglia, and then to the thalamus and back to the cortex, possibly providing a mechanism for 'you' to exercise agency control over motor and possibly even thought outputs. The basal ganglia can be conceptualized as a combination of 'gas and brake pedals' and potentially a 'selection switch.'

*Buffalo Brain Museum.*

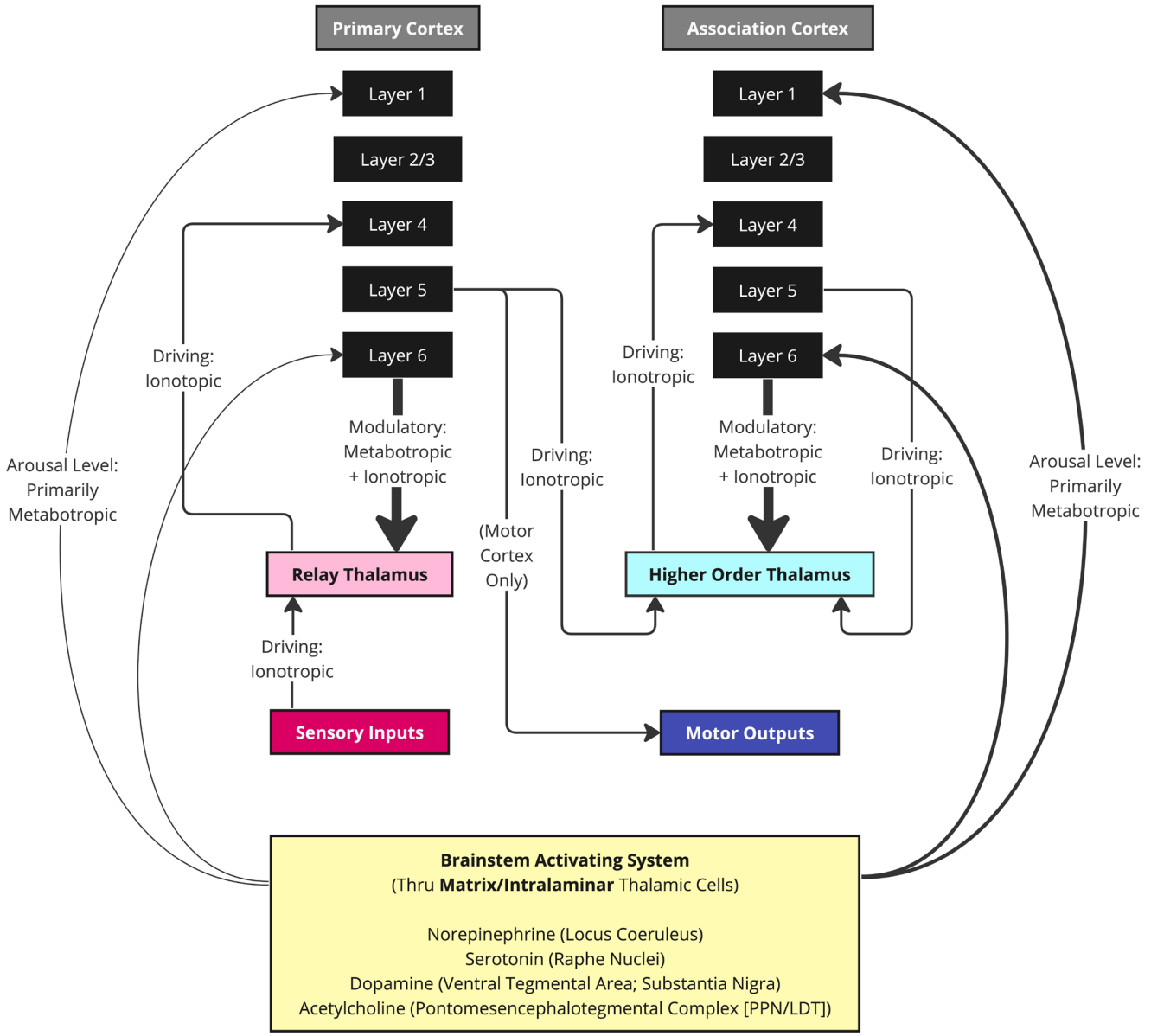
In the displayed coronal brain slice from the Buffalo Brain Museum, the caudate is highlighted by green circles, while the putamen and globus pallidus are near the orange circles. Positioned anteriorly is the nucleus accumbens. Perhaps activity in the prefrontal cortex (just prior to moving to the basal ganglia) could be indicating moments of conscious override of autonomy of behavior. Leonard White, of Duke University, has suggested that caudate may be more for eye/mind movement, the putamen more for body movement, and the nucleus accumbens for affect.

Before we leave the basal ganglia, there's the substantia nigra (the region affected in Parkinson's) which provides dopamine to the system. The nucleus accumbens also releases dopamine, encouraging the behaviors that we find to result in 'better than expected' results.



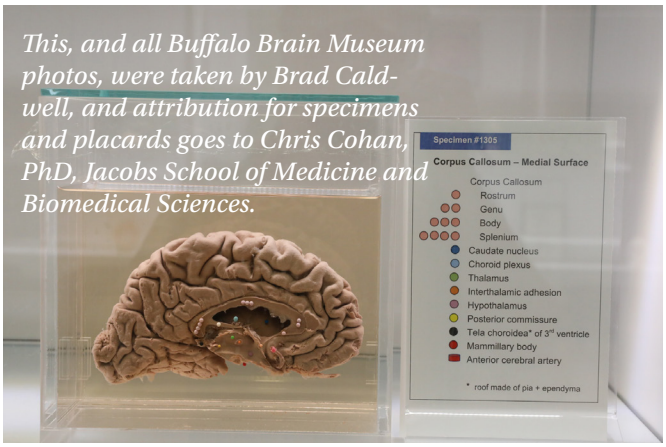

## Thalamus

The thalamus has all kinds of fascinating circuits. In the depiction on the facing page, you can see the basic feedforward and (context?) feedback pathways. But even the return path from cerebellum back to cerebrum passes through the thalamus, as does the one from the basal ganglia back to the cerebrum. In this figure, feedforward sensation signals use ionotropic receptors for millisecond-level low-latency precision. Metabotropic receptors convey activity with latency, and for




longer lasting durations. Most connections in the thalamus are from the cortex (layer 6) to the thalamus, rather than vice-versa. But, these connections target distal regions of dendrites, where they provide a slower, modulatory effect. The sensory feedforward inputs to the thalamus, though few, target close to the soma of neurons, where they can reliably get their message through to the cortex.

So what do we have here? Perhaps there is some integration of content to context here, although that is still speculative. When you awake, it is because the brainstem activating system releases 'levels neurotransmitters,' primarily to the association cortices, but partially to primary cortices as well. It is at the level of association cortices that consciousness appears to arise.

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**Hippocampal Area**

Patient H.M. (Henry Molaison), a pivotal figure in neuropsychology, underwent a bilateral medial temporal lobotomy, including significant hippocampal removal, to treat his epilepsy. This operation resulted in severe anterograde amnesia, impeding his ability to form new explicit memories, though some memory and learning functions remained.

In terms of facial recognition, H.M.'s case was complex. Post-surgery, he couldn't form new explicit memories, including the recognition of new faces like his doctors and caregivers. Every meeting felt like the first encounter to him. While H.M. maintained some implicit or procedural memory, which operates subconsciously and includes skills and habits, there's no evidence he developed this implicit recognition for new faces post-surgery. His interactions with people he met after the surgery always felt like initial meetings.

In comparison, Clive Wearing[12], another notable neuropsychology case, suffered from encephalitis that affected his hippocampus and areas like the prefrontal cortex, while preserving his musical abilities and language skills. Wearing experienced both anterograde and retrograde amnesia. He described feeling as if he was perpetually in a state of new consciousness, akin to standing on the edge of oblivion. In his journal, he repeatedly expressed the sentiment of becoming conscious for the "first time," reflecting the depth of his memory loss. Clive said: "I've never been conscious [no memory of being conscious]...So I've never been bored or upset. I've never been anything at all, it's exactly the same as death. No dreams even. Day and night, the same." It's probably best to interpret this as follows: he actually did have dreams and perceptions—but because he had no conscious memories, the present felt being dead, 'until now.'

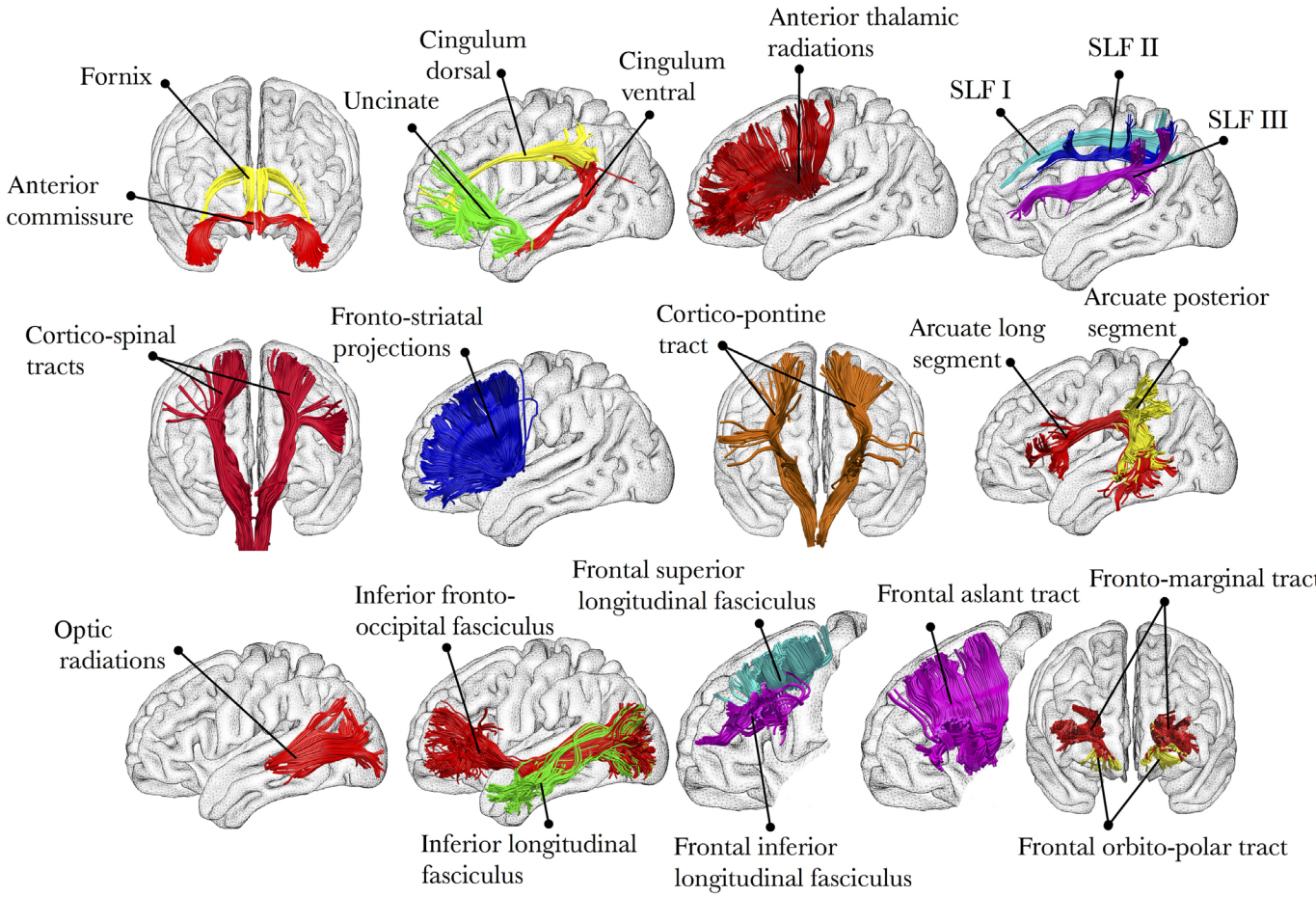
Clive Wearing's experience indicates that damage to the hippocampus and prefrontal cortex can profoundly affect aspects of consciousness. This raises the question of whether the hippocampus might be central to consciousness itself—it is a profoundly serial, ring-like process going through the hippocampus. However, the case of H.M.—whose hippocampi were removed—suggests consciousness is getting created elsewhere, and a complex 'what' is getting laid down in the hippocampus to enable later recall at any similar stimuli.

12 Wearing, D. (2006). Forever Today. Soundings.

Additionally, Phineas Gage's famous injury, where a rod penetrated his prefrontal cortex without completely destroying it, adds another dimension to this discussion. Remarkably, Gage remained conscious, with no apparent disruption to the core mechanisms of consciousness, although his injury may have impacted his 'filters.' This suggests that while these brain regions are crucial for certain functions and traits, they may not singularly define consciousness.

Lonnie Sue Johnson's battle with encephalitis led to the destruction of her hippocampi and adjacent areas, as well as some damage to her parietal and temporal lobes. This resulted in both anterograde and retrograde amnesia. While it's challenging to pinpoint precisely where retrograde memories or their triggering mechanisms are stored, the hippocampus is evidently crucial for storing (or triggering) memories in the 30-second to 30-day range for new episodic memories.

The exact locations for the storage of longer-term episodic memories, spanning from 30 days to 30 years, are not definitively known. However, it's hypothesized that the prefrontal, temporal, and parietal lobes may be involved in storing these memories, as well as in facilitating the ability to recall them in response to relevant triggers or similarities.




### Intra-Cerebral Connections

Besides the major loops beginning and ending in the cerebrum, there are plenty of intra-cerebral connection paths (some are illustrated beautifully above[13], in addition to portions of the loops we have already discussed). In humans, the arcuate connection is prominent, and may contribute to our language abilities, as it connects Broca's and Wernicke's areas—areas prominent for generating speech and understanding spoken language, respectively.

The corpus callosum is a huge connection serving to link the left and right hemispheres. The Superior Longitudinal Fasciculi (SLF) I, II, and III are connections linking posterior and anterior cortices. The fronto-striatal projections are the loop to the basal ganglia. The cortico-pontine tract is the loop going to the pons and then to the cerebellum. Cortico-spinal tracts carry signals from mostly motor cortex eventually to muscles. Optic radiations connect visual cortex with the visual thalamus. There are even connections between the prefrontal cortex and the occipital (visual)

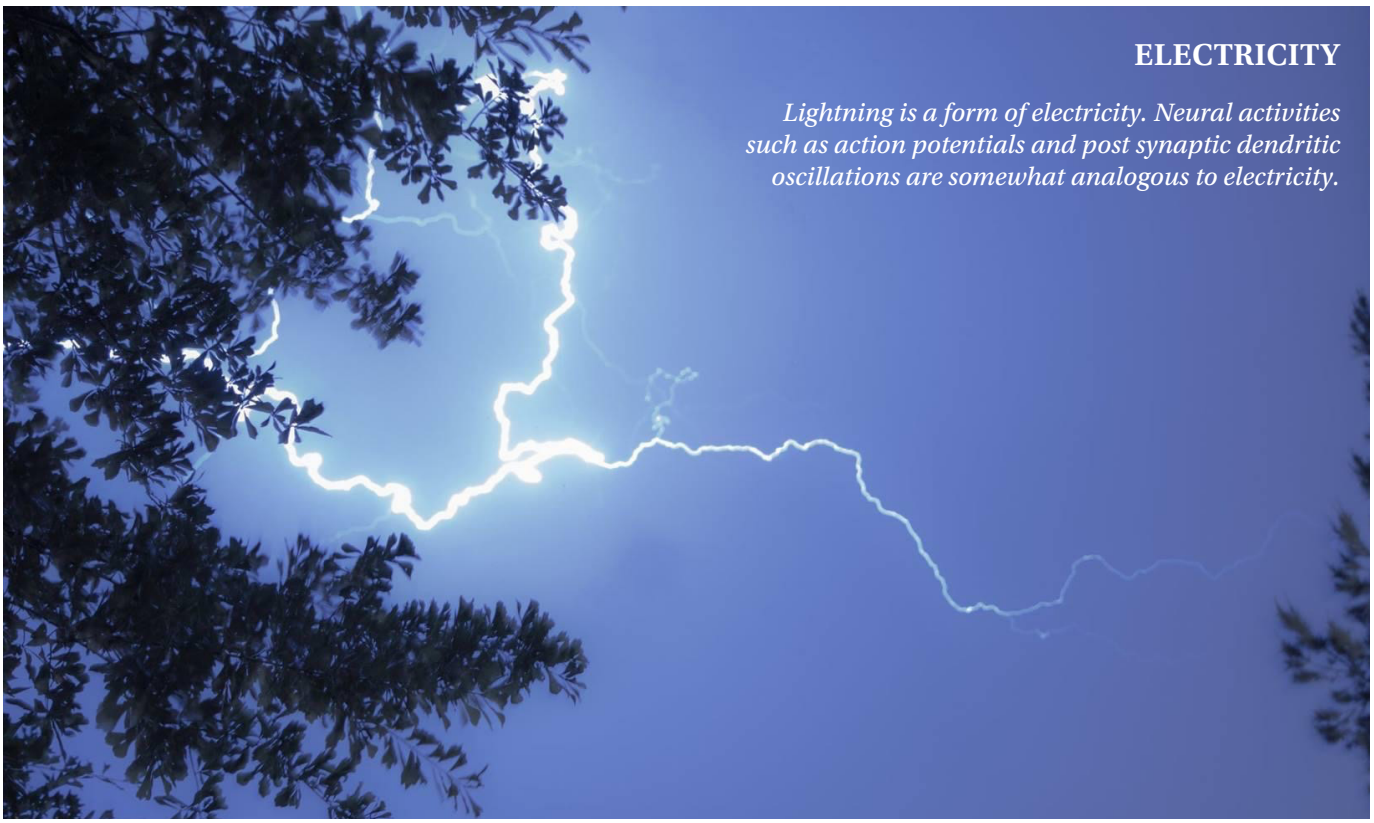
13 Thiebaut, M. (2015). Tracts of human brain.png. Wikimedia. Retrieved 2023, from https://en.m.wikipedia.org/wiki/File:Tracts_of_human_brain.png, Creative Commons license.

cortex, and from there to the temporal lobe. The anterior commissure connects the left and right temporal lobes, including for the hippocampus and for olfaction.

In general, sensory stimuli come in to the back half of the brain, and salient stimuli will eventually make it all the way to the hippocampus and prefrontal cortex—regions that appear to be the top of the hierarchy of attention and conscious decision. When a green light signal comes through to tell a runner to begin racing, you can see the cumulative delay as the information goes from eye to lateral geniculate nucleus of thalamus (50 ms) to primary visual cortex (70 ms) to fusiform gyrus and posterior parietal cortex (110 ms) to prefrontal cortex (140 ms)—***ostensibly where the decision is made to begin running***—to premotor cortex (170 ms) to motor cortex (200 ms) and finally to muscle activation (250 ms).[14]

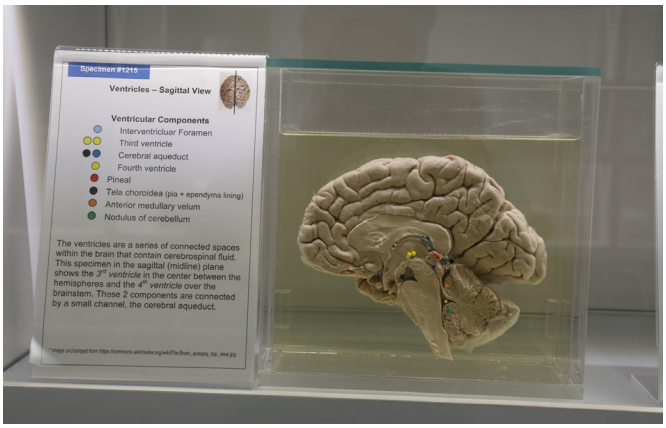
While we're discussing large circuits, consider that the brain is capable of running many 'threads' in parallel (simultaneously), like a powerful computer with multiple cores. This 'threading' seems to allow the phenomenon of decoupling, where attention and response needn't be 'knee-jerk,' but can operate on their own. Conscious

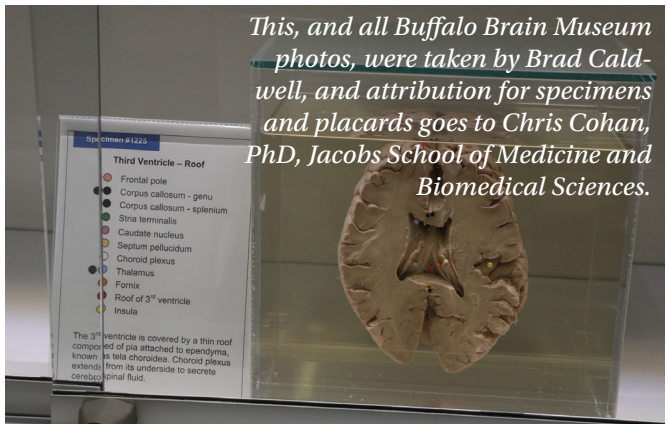
14 Extrapolated from data in: Thorpe, S. J., & Fabre-Thorpe, M. (2001). Seeking categories in the brain. Science, 291(5502), 260–263. https://doi.org/10.1126/science.1058249



**ELECTRICITY**

*Lightning is a form of electricity. Neural activities such as action potentials and post synaptic dendritic oscillations are somewhat analogous to electricity.*

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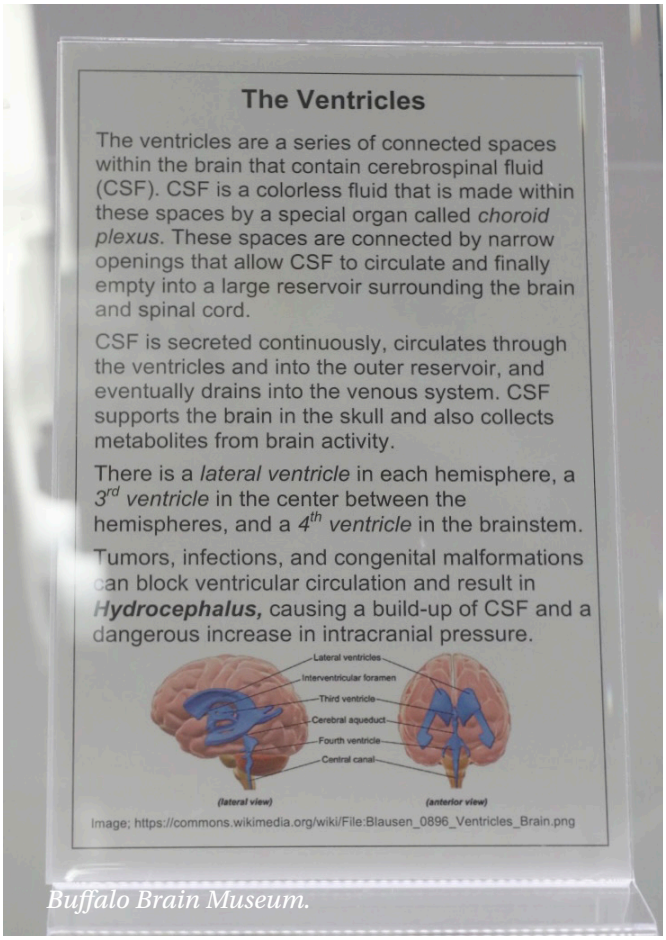
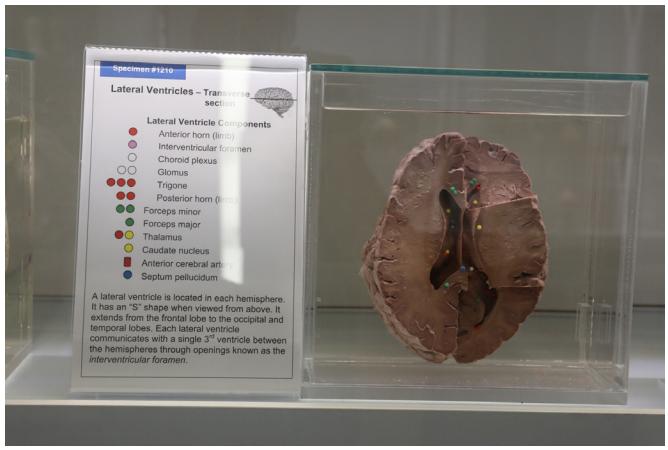
processes, however, seem to require a single core, harking back to our chapter on the binding problem. So, whatever process or phenomenon underlies conscious experience, it apparently is incapable of existing in any way other than serially (singly).

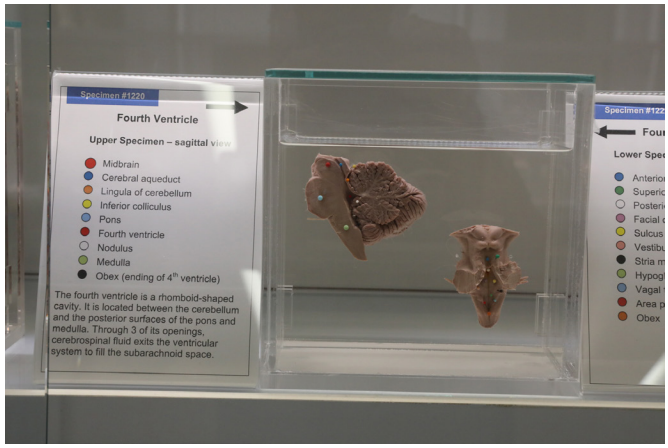



*Buffalo Brain Museum.*

Also pertinent to this chapter is the notion of the cortico-thalamo-cortico resonant circuit, which figures like Rodolfo Llinás and Christof Koch have




proposed as a potential seat of consciousness, potentially operating around ~40 Hz. In 'I of the



Vortex,' Llinás suggests that the interplay between specific and non-specific thalamic cells and dynamic cortical regions could spotlight content for conscious experience.[15] Christof Koch, from an Integrated Information Theory (IIT) perspective, identifies the 'Posterior Hot Zones' (mainly the Posterior Parietal Cortex) as a consistently active area that, through resonance, might be central to consciousness.

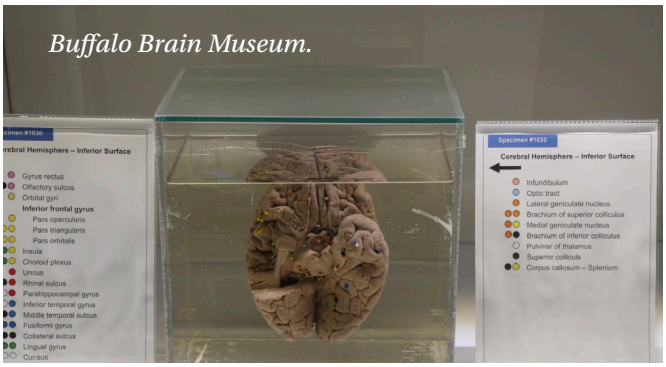
Bernard Baars (Global Workspace Theory, GWT), emphasizes the significant top-down contextual influences that intertwine with explicit content to shape conscious experience, suggesting a more extensive role for the hippocampus, thalamus, and particularly the prefrontal cortex in consciousness generation. While 'hot zones' might be instrumental in forming the real-world schema, the genesis of imagination and contextual frames appears to extend beyond these zones.

Llinás also contributes valuable insights, particularly regarding central pattern generators (CPGs). He explores the idea of CPGs in simple organisms and extrapolates this to the human brain, speculating that the inferior olive might act as a sophisticated CPG, issuing rhythmic 'go' signals to the cerebellum at frequencies around 2 Hz, possibly varying up to 12 Hz or in staggered patterns.

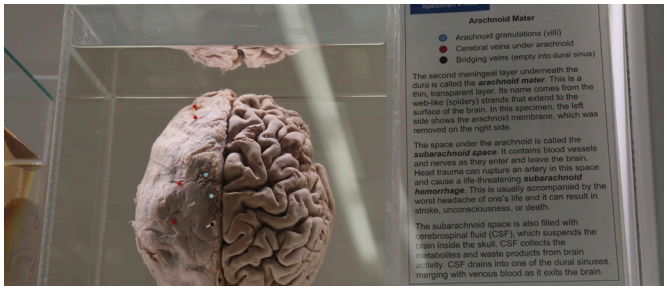
Central pattern generators (CPGs) can be simplified as follows: imagine you are a bacteria with a flagella—neuron population A engages a left bend of the flagella while also activating neuron population B. Then neuron population B engages a right bend of the flagella while also activating neuron population A. This goes back and forth rapidly, automatically, and the bacteria moves forward consistently. This is a bit of a simplification, but one you can get your mind around.

Llinás also delves into Fixed Action Patterns (FAPs), which are instinctive behavioral sequences triggered by specific stimuli and carried out to completion once initiated. The difference between FAPs and CPG-driven actions lies in the nature of the stimulus and response. While CPGs are intrinsic neural circuits producing rhythmic patterns, FAPs are responses to external stimuli resulting in a predefined sequence of actions.

15 Llinás, R. R. (2008). I of the vortex: From neurons to self. MIT Press.



*Buffalo Brain Museum.*



# 5

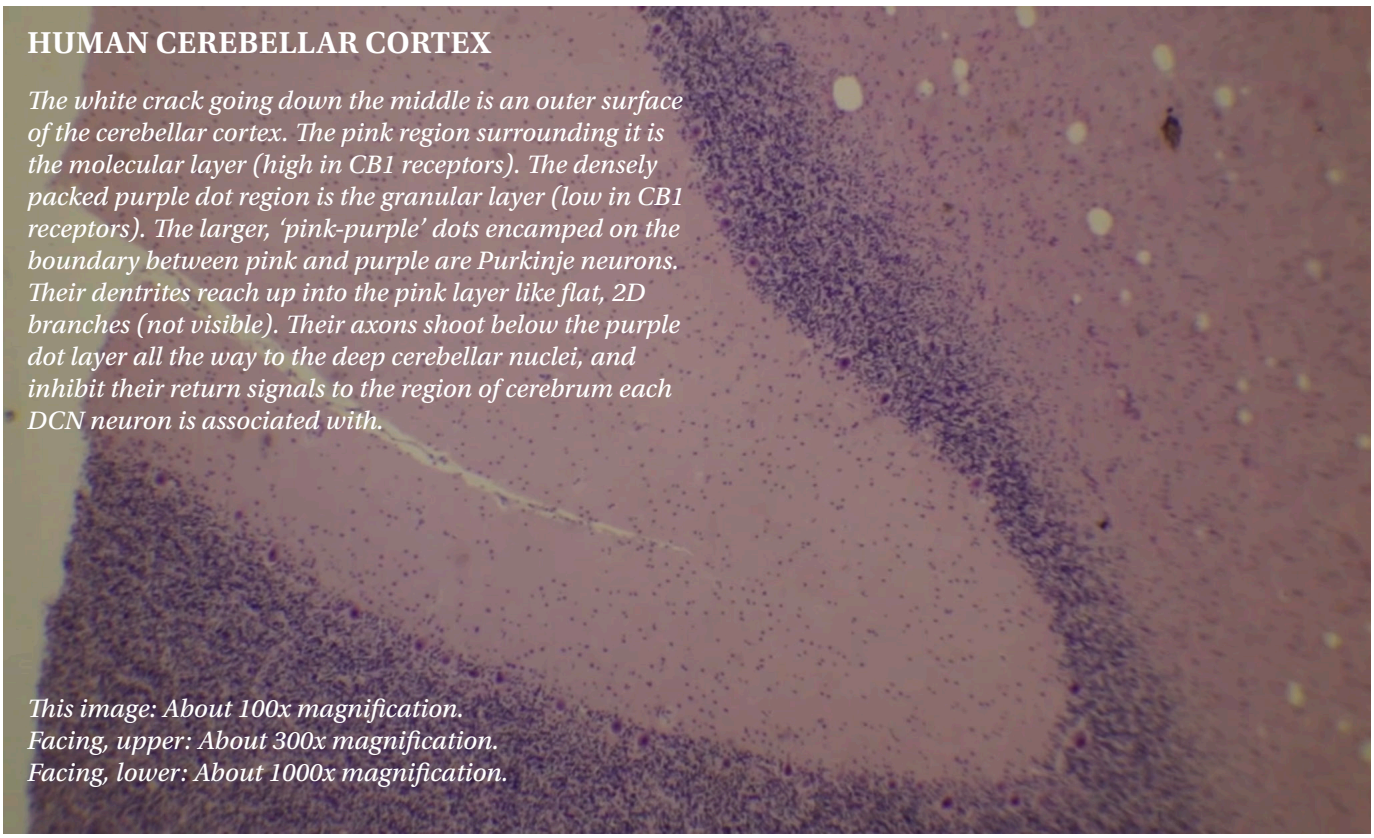
## *Brain Circuitry — Micro Scale*

*The way you see...hear...think...do language...[and] engineer things is all the same basic learning algorithm.—Jeff Hawkins*

It's been said that the brain is the hardest organ to understand because it has extreme complexity across six orders of magnitude. Pictured here is the cerebellar cortex, zooming from 100x to 1000x.

**Purkinje Cells of Cerebellum**

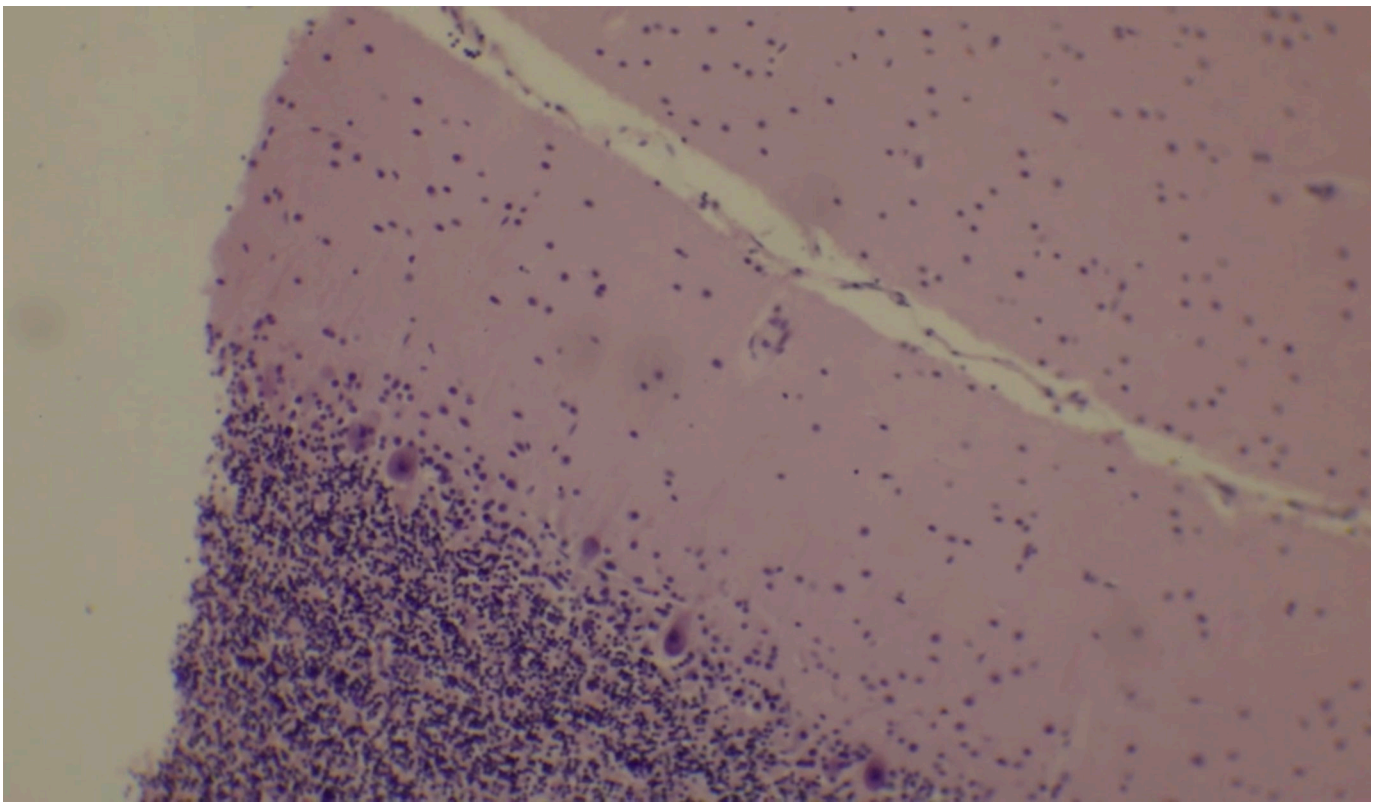
The 'tadpole' light-purple, larger cells on the border between pink and purple are Purkinje cells. They are very unique because the dendrites

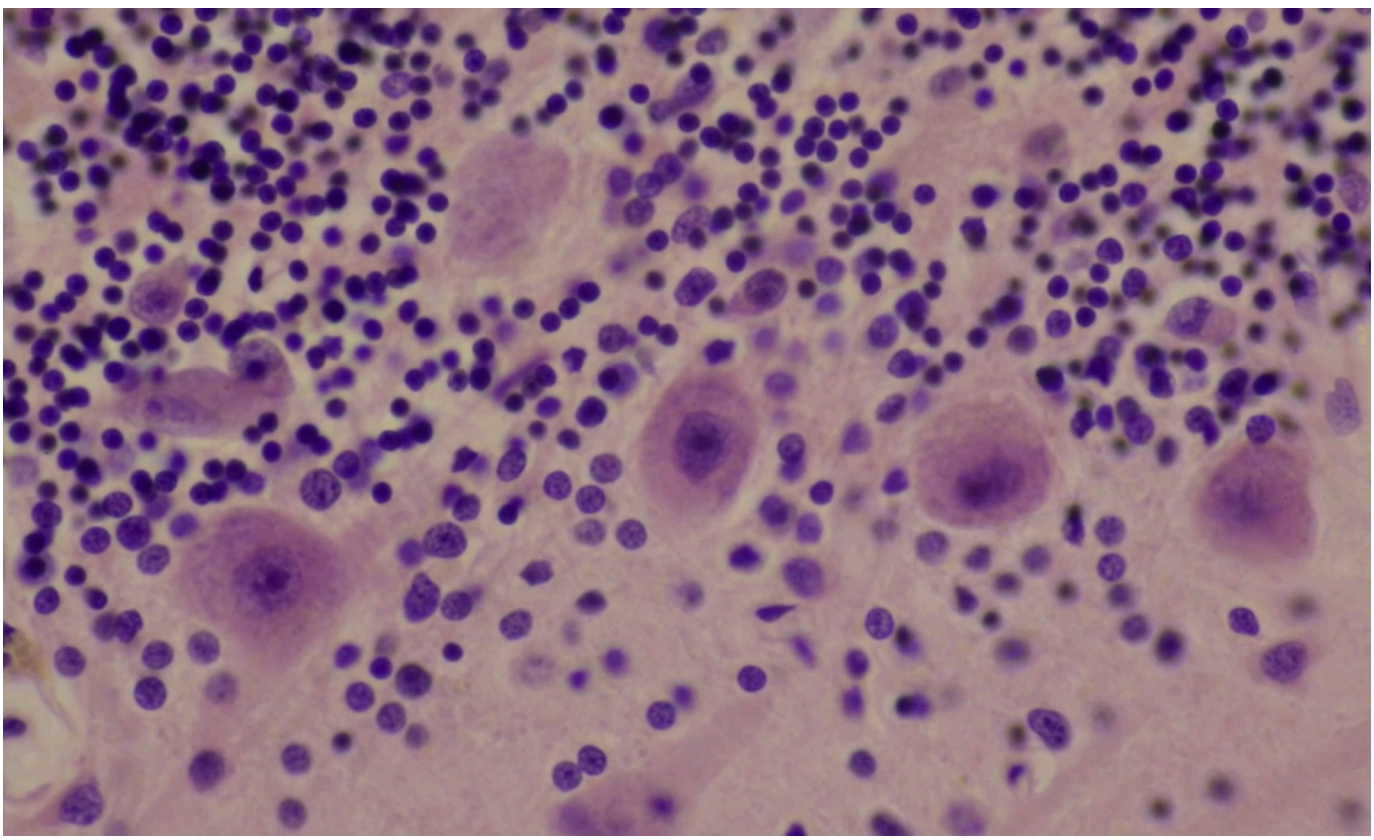


**HUMAN CEREBELLAR CORTEX**

*The white crack going down the middle is an outer surface of the cerebellar cortex. The pink region surrounding it is the molecular layer (high in CB1 receptors). The densely packed purple dot region is the granular layer (low in CB1 receptors). The larger, 'pink-purple' dots encamped on the boundary between pink and purple are Purkinje neurons. Their dentrites reach up into the pink layer like flat, 2D branches (not visible). Their axons shoot below the purple dot layer all the way to the deep cerebellar nuclei, and inhibit their return signals to the region of cerebrum each DCN neuron is associated with.*

*This image: About 100x magnification.*
*Facing, upper: About 300x magnification.*
*Facing, lower: About 1000x magnification.*





arrange in a nearly perfect 2D planar style. That would be perfect for rings, right? Well, probably not for the consciousness of them (one can lose their cerebellum and apparently still be okay), but perhaps it can calculate extreme precision of ***time,*** which seems to be used as medium of exchange for one axis of representational ***space*** in at least the fusing schema, at times. Or, perhaps it allows for interpolation between frames so as to have an increased sampling rate of the 3D location of limbs and objects. Whatever its mechanism, the cerebellum makes one capable of faster, real-time adjustments, and of finer temporal and spatial precision.

In his Udemy course on Master Neuroscience and Neuroanatomy, Dr. Najeeb tells telling tales of cerebellar disruption. Using a student volunteer as an example, he asks the volunteer to smack himself on the face, but Dr. Najeeb will hold the student's hand so they can't. They build pressure in the hands, and then Dr. Najeeb pulls his hand away, and the student nearly smacks himself in the face, but stops the motion of the hand just in time. ***This***, he says, is pure cerebellar function. Those with cerebellar damage cannot stop their own hand in time. And neither can they touch their index fingers together with eyes closed. They have lost much if not all of the sense of proprioception—understanding where limbs are in space.

In the facing image, you can see several Purkinje cells with their planar branches.[16] Background Purkinje cell image again shows planar nature.[17] Facing page, bottom shows basic cerebellar Purkinje cell circuitry.[18] Facing page, upper right shows the structure of the cerebellum, as well as a projection of where the deep cerebellar nuclei would appear even though they are below the surface.[19] They've discovered another pair of left/right homunculi on the mid-cerebellum (in addition to the one at the top, and the two at the base).[20]

So these homunculi are all oriented in nearly 90° orthogonal planes—maybe they are representing a sort of x,y,z (send signals to each to get

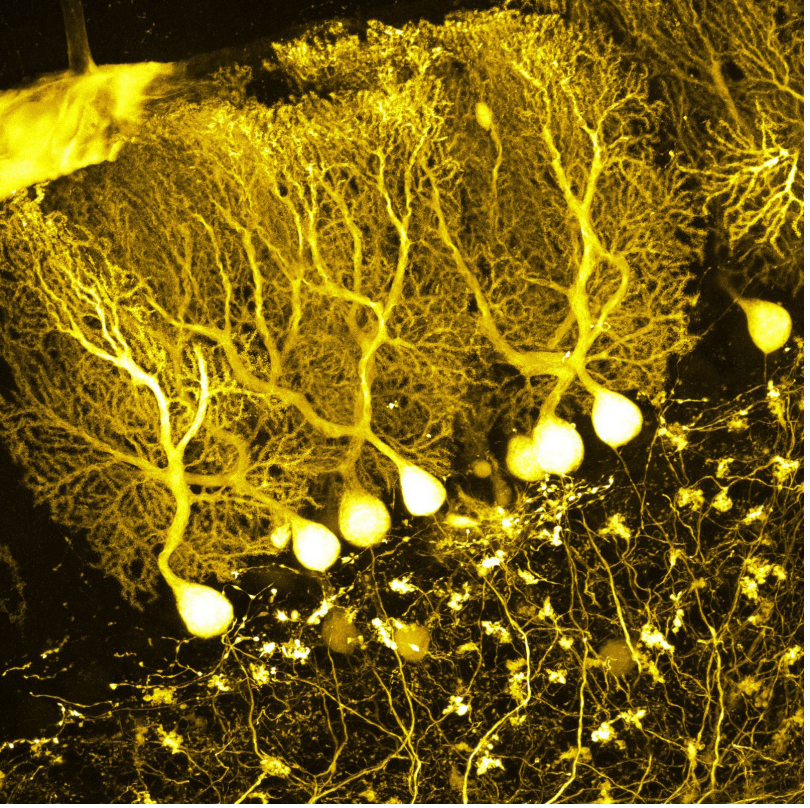
16 BrainsRusDC, CC BY 4.0 <https://creativecommons.org/licenses/by/4.0>, via Wikimedia Commons.

17 Internet Archive Book Images, No restrictions, via Wikimedia Commons.

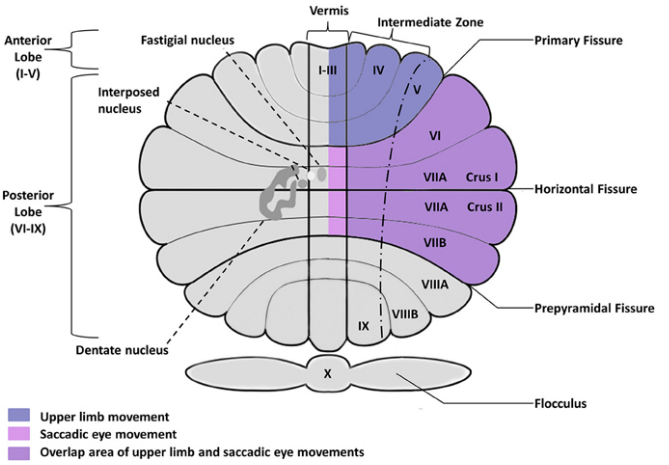
18 Tom282f3, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons.

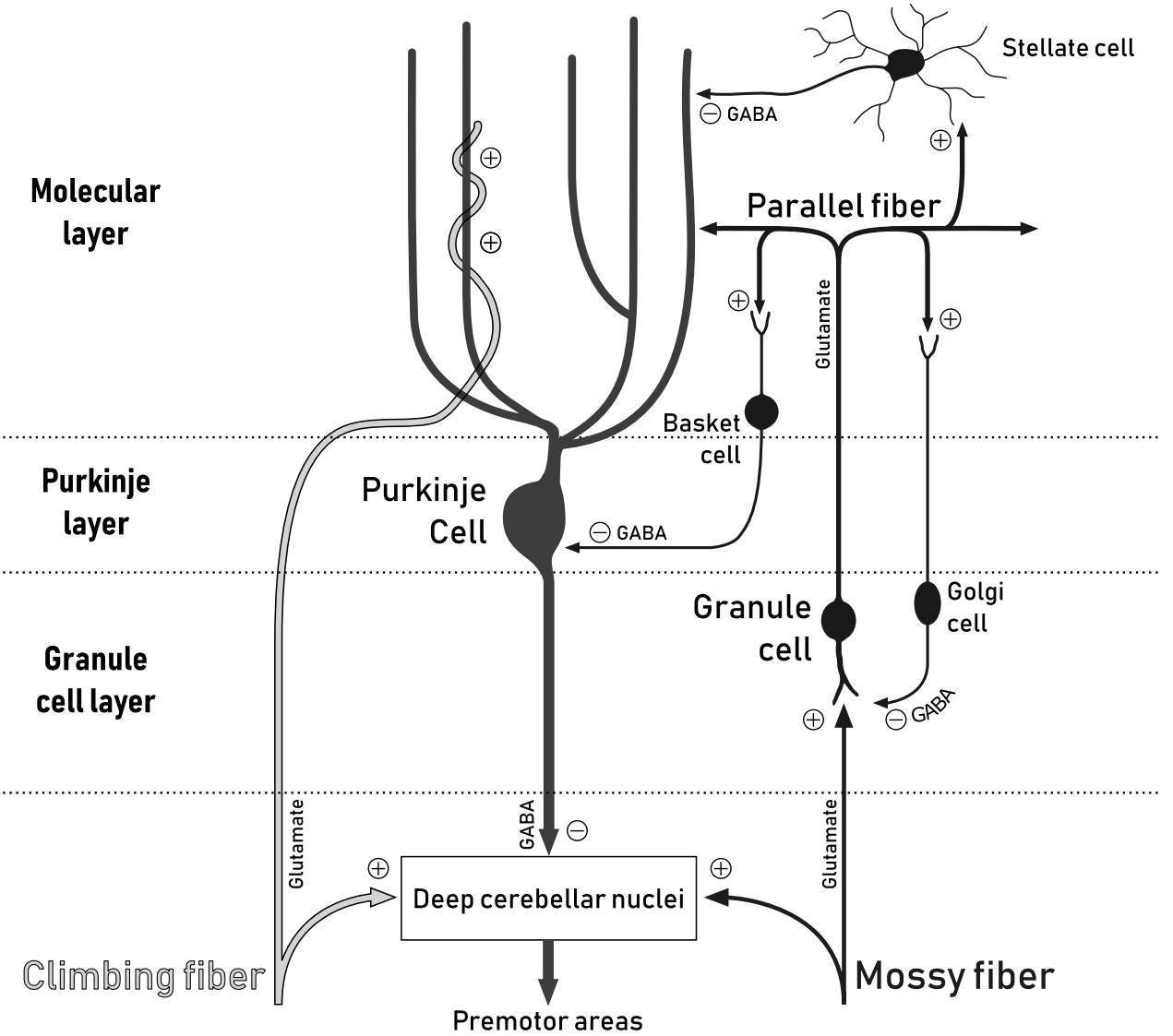
19 Matthew W. Mosconi, Zheng Wang, Lauren M. Schmitt, Peter Tsai and John A. Sweeney, CC BY 4.0 <https://creativecommons.org/licenses/by/4.0>, via Wikimedia Commons.

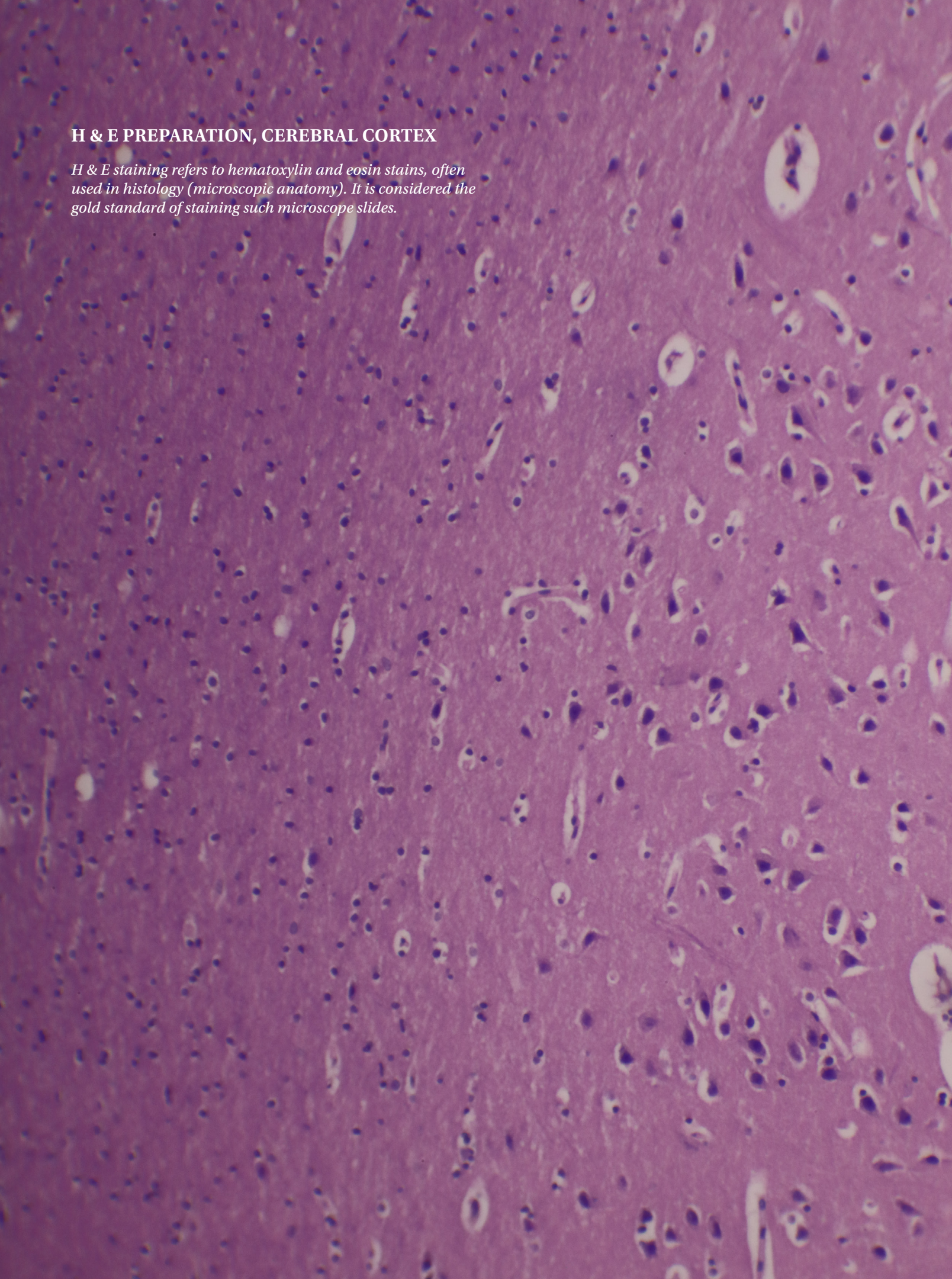
20 Schlerf, John & Wiestler, Tobias & Verstynen, Timothy & Diedrichsen, Jörn. (2014). Big Challenges from the Little Brain — Imaging the Cerebellum. 10.5772/58266.



## PURKINJE CIRCUITRY & THE CEREBELLUM





## H & E PREPARATION, CEREBRAL CORTEX

*H & E staining refers to hematoxylin and eosin stains, often used in histology (microscopic anatomy). It is considered the gold standard of staining such microscope slides.*


## SILVER IMPREGNATION PREPARATION

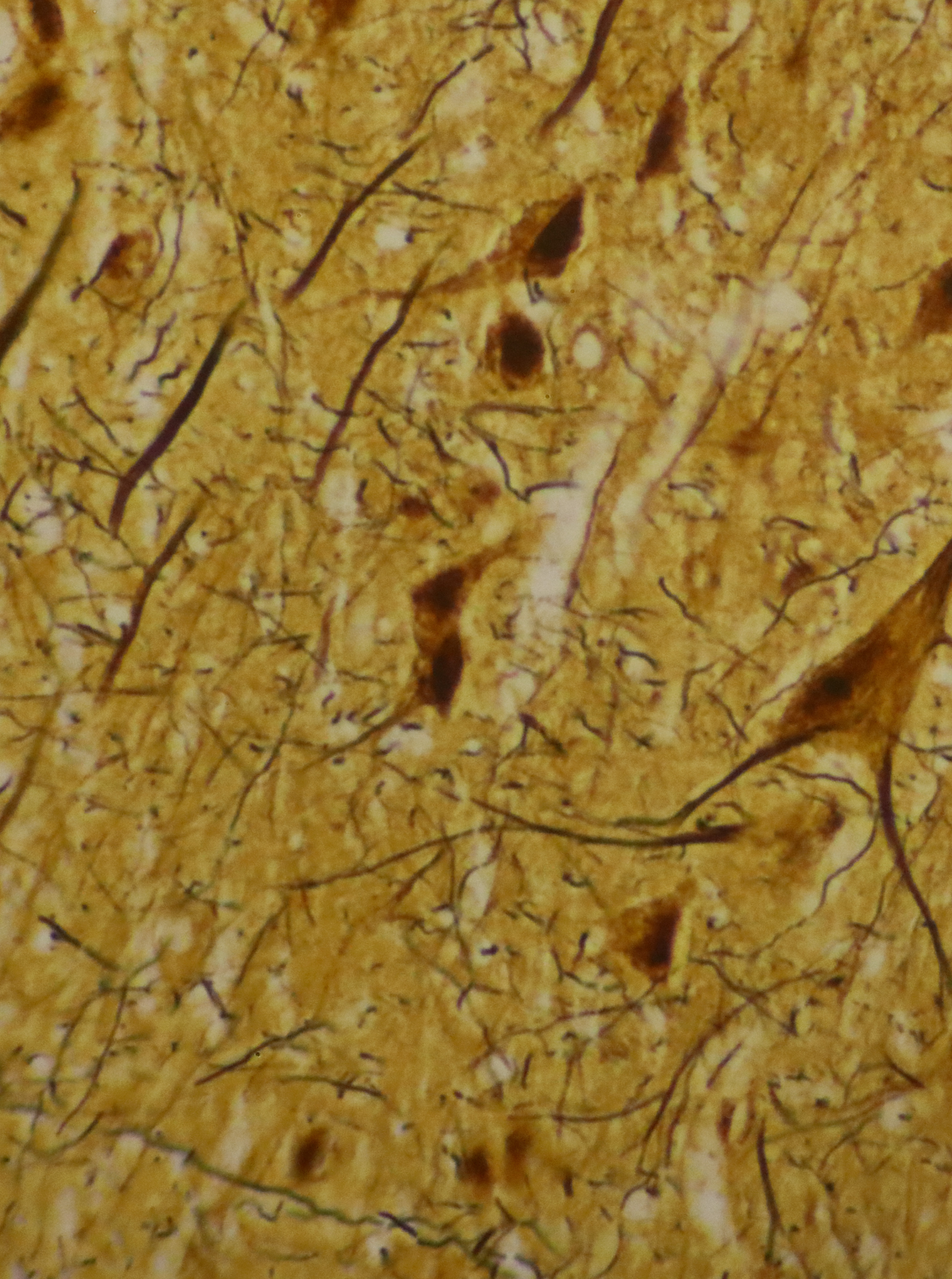
*This is a slice of human cerebral cortex. The direction of the columns are fairly evident (birectional arrow), but the layers are not clear and there is no easy way to discriminate the boundaries of microcolumns.*


Layer 1
Layer 6

## PYRAMIDAL NEURONS

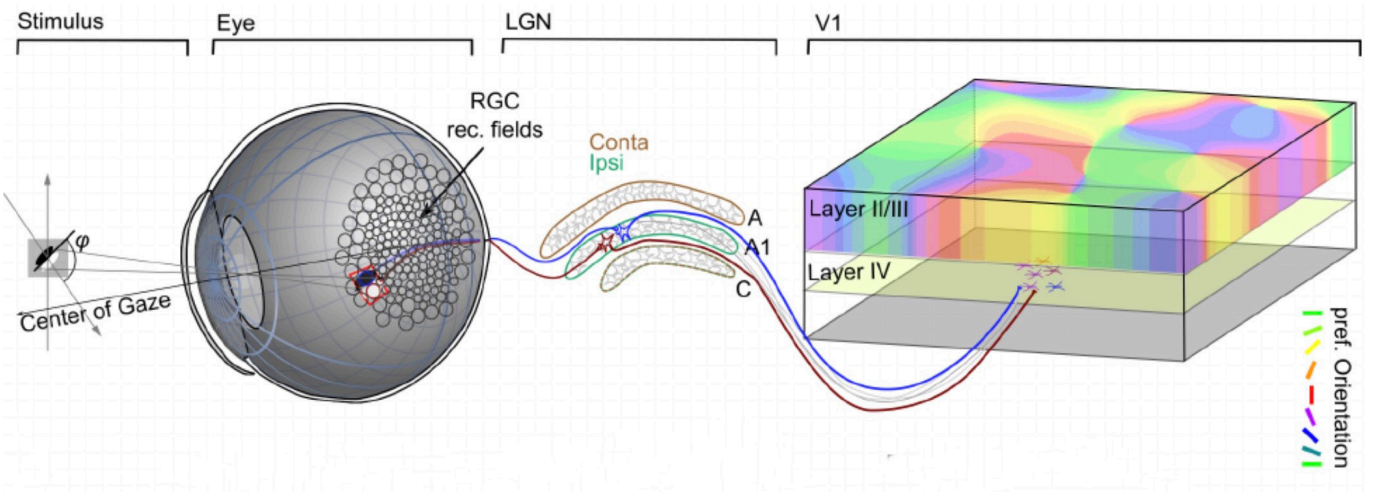
*In this silver impregnation microscope slide image, which seems to have a sort of banana bread appearance, pyramidal cells are clearly visible (one is labeled). This is a high magnification image of the cerebral cortex.*

*Facing: Another shot of cerebral cortex, layers 1-6.*



## GIANT PYRAMIDAL NEURON

*At the center of this two-page spread is a huge pyramidal cell. You can see the somewhat triangular or pyramidal structure of the cell body, and a large dendrite coming out the top, as well as two possible basal dendrites going down like roots. The axon that goes downwards is probably too small to see, even at this large magnification (about 2000x), or may have been sheared off where it is not even present in this microscope slide preparation.*




**VISUAL PATH, STIMULUS-TO-V1, PINWHEELS**

*V1 refers to Visual Cortex 1, the part of the occipital cortex the furthest back. The middle component, LGN, is the lateral geniculate nucleus of the thalamus. You can see pinwheel structure in layers 2/3 of V1, of line orientation preference.*

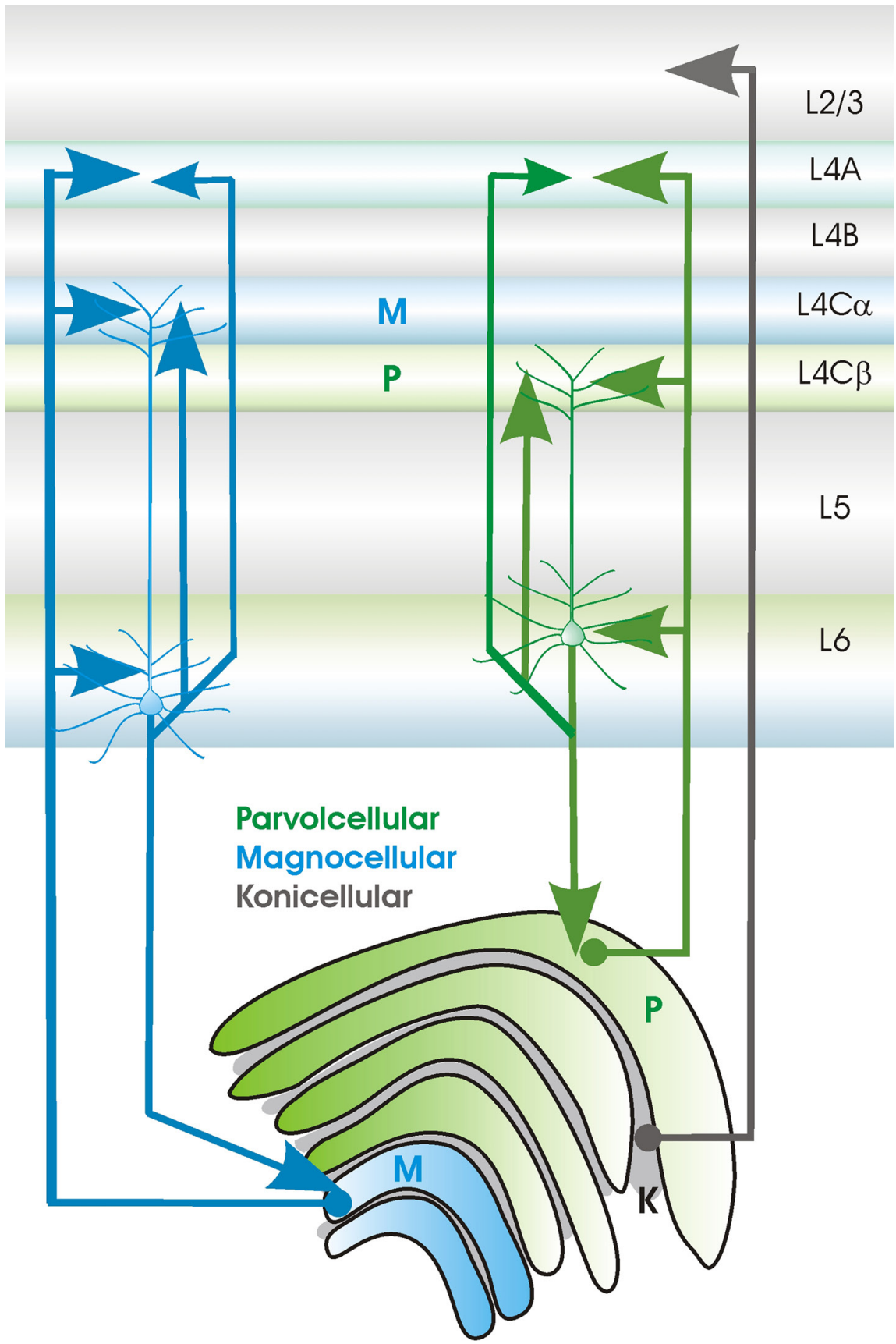
*Image credit: TY - JOUR, AU - Schottdorf, Manuel, AU - Keil, Wolfgang, AU - Coppola, David, AU - White, Leonard, AU - Wolf, Fred, PY - 2015/10/01, SP - , T1 - Random Wiring, Ganglion Cell Mosaics, and the Functional Architecture of the Visual Cortex, VL - 11, DO - 10.1371/journal.pcbi.1004602, JO - PLOS Computational Biology, ER -. https://creativecommons.org/licenses/by/4.0/. Image cropped.*

# THE VISUAL PATH TO THE CEREBRAL CORTEX

**FACING PAGE: VISUAL INPUT, GOING FROM LGN TO V1**

*The six-layered 'bent knee' at bottom is the lateral geniculate nucleus (LGN). It has parvocellular, magnocellular, and koniocellular layers which project a little differently to the layers of the primary ('striate') visual cortex.*

*Image credit (for this image, and the two on pages 93-94): Author: Thomson Alex. Title: Neocortical layer 6, a review. Journal: Frontiers in Neuroanatomy. Volume 4 Year 2010. Url: https://www.frontiersin.org/articles/10.3389/fnana.2010.00013. DOI: 10.3389/fnana.2010.00013. ISSN=1662-5129. Abstract: This review attempts to summarise some of the major areas of neocortical research as it pertains to neocortical layer 6. After a brief summary of the development of this intriguing layer, the major pyramidal cell classes to be found in layer 6 are described and compared. The connections made and received by these different classes of neurones are then discussed and the possible functions of these connections, with particular reference to the shaping of responses in visual cortex and thalamus. Inhibition in layer 6 is discussed where appropriate, but not in great detail. Many types of interneurones are to be found in each cortical layer and layer 6 is no exception, but the functions of each type remain to be elucidated (Gonchar et al., <xref ref-type="bibr" rid="B39">2007</xref>). https://creativecommons.org/licenses/by/4.0/.*


L2/3
L4A
L4B
L4Cα
L4Cβ
L5
L6
M
P
Parvolcellular
Magnocellular
Konicellular
P
M
K

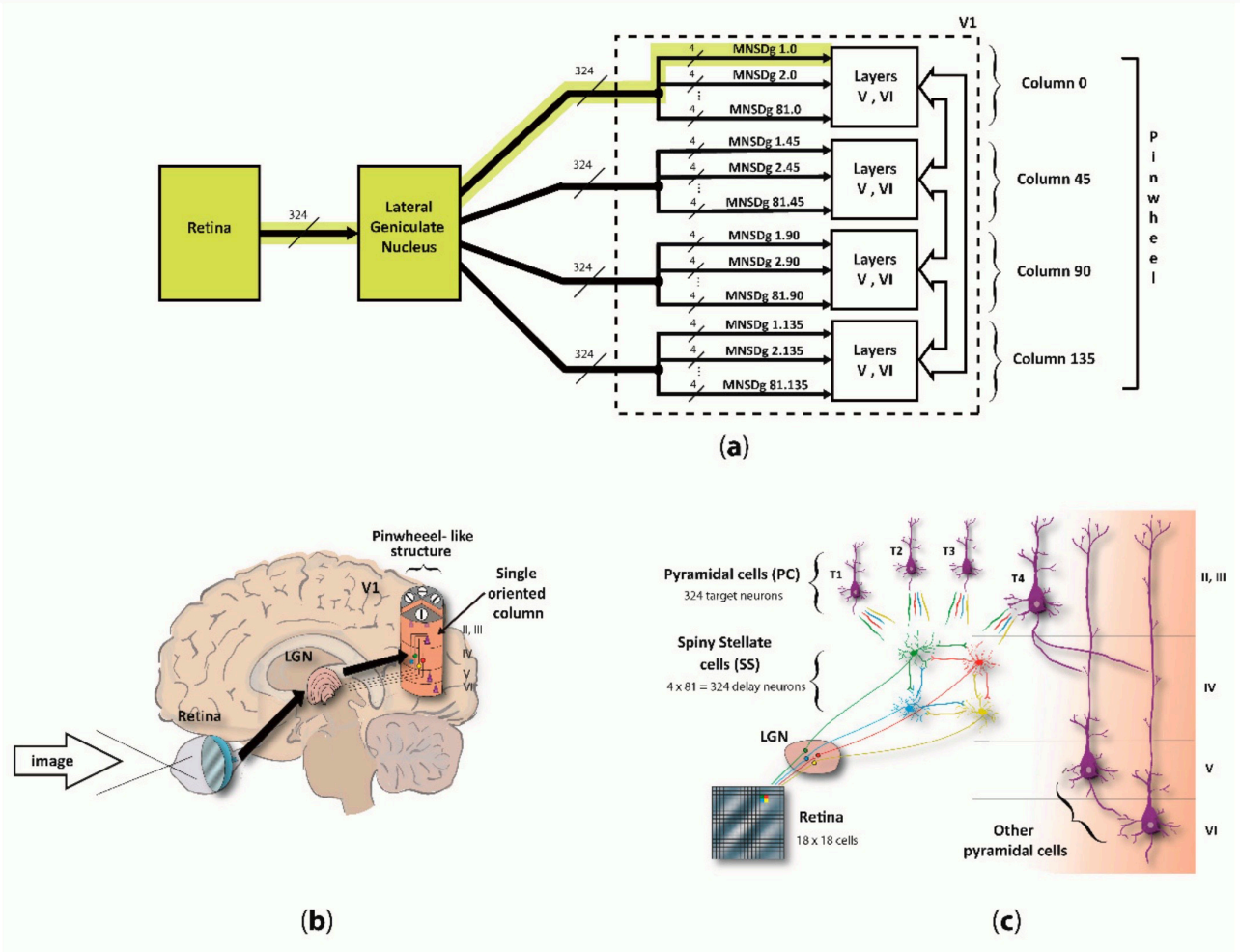
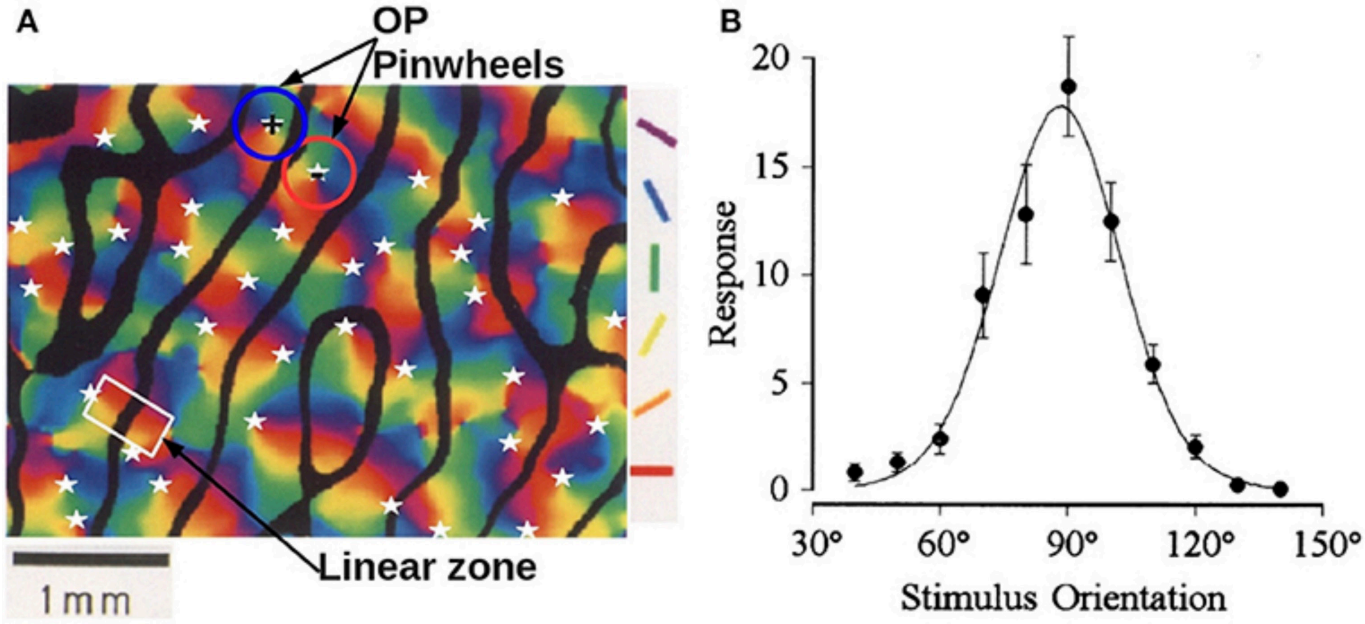



**Figure 1.** Illustration of the RVSM.: (**a**) Wiring scheme of the complete system, from the 324 cells of the retina to the MNSD-based microcircuits residing in layers II/III and IV (connection cardinality is indicated along the tracts). Each one of the 4 columns (i.e., *column 0*, *column 45*, *column 90* and *column 135*) is composed of 81 MNSD groups, and indicated with the notation $ID_{MNSD\ group}.ID_{column}$ (e.g., MNSDg 2.45 means the 2nd MNSD group of cortical column 45). Neurons of layers V and VI are shared among the MNSD structures; (**b**) Anatomical contextualization of the neuronal path highlighted in (**a**): from stimulus presentation to one of the four V1 oriented columns composing the *pinwheel-like* structure; (**c**) Diagram of neuronal connections from a specific section of the retina (represented by 4 neighboring cells out of the 324) to a single MNSD-based microcircuit of one of the four cortical columns (delay neurons of layer IV to target neurons of layer II/III). The output connections to layers V and VI are shown for one of the targets only. For ease of understanding, in (**b**) we depicted only the MNSD structure formed with one of the targets, although each set of four delay neurons (layer IV) is connected to four target neurons (levels II/III) giving rise to four different MNSD structures, i.e., a MNSD group (as specified in (**c**)). The reader can find a precise description of the network in the Section Materials and Methods and in Appendix B.

## RETINA-LGN-V1 PATH, PINWHEELS

*Letter (b) delineates the path of visual information (however, some gets split off to go to the superior colliculus).*




## LINE ORIENTATION PREFERENCE PINWHEELS, OCULAR DOMINANCE BOUNDARIES

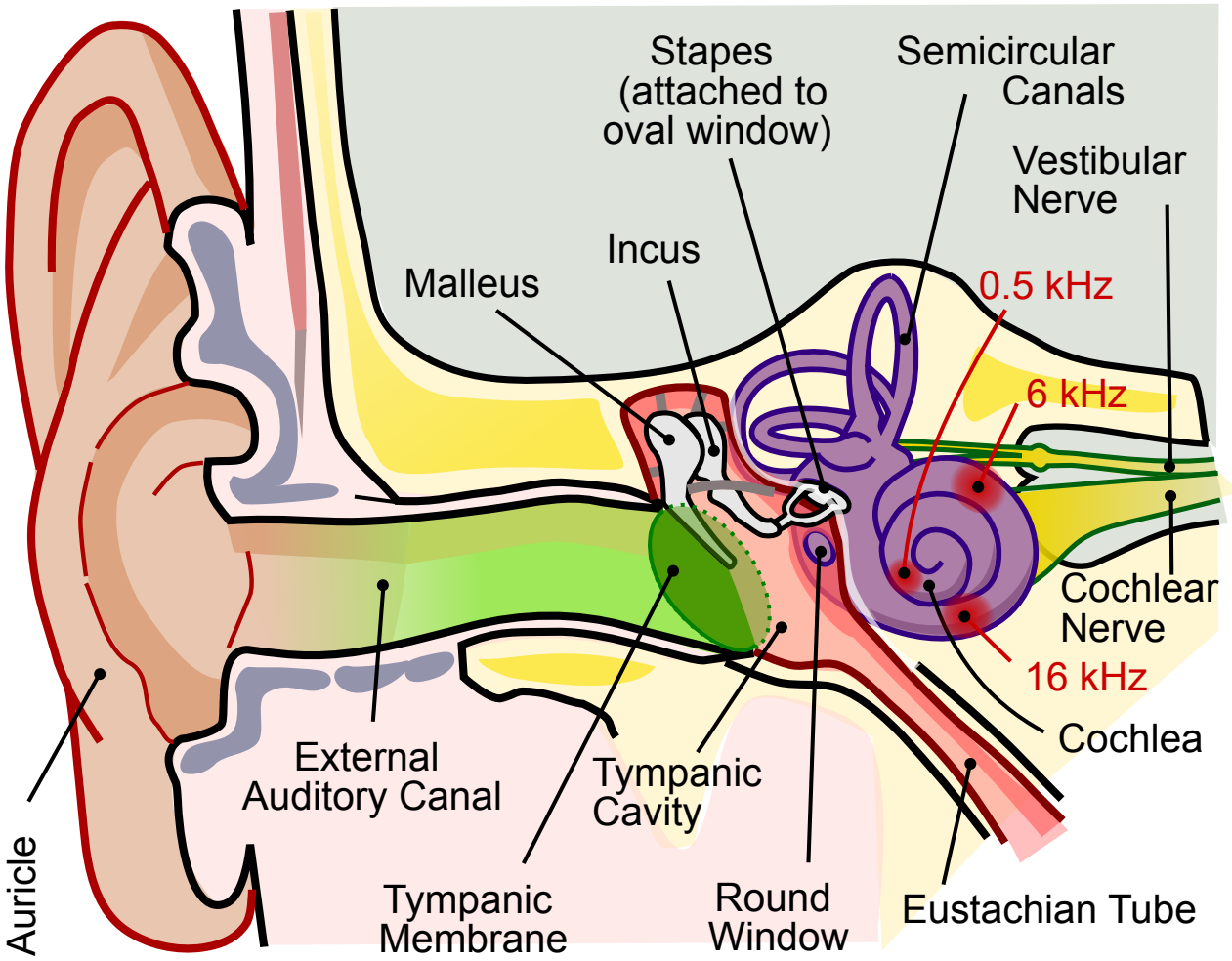
*Each color is representing a line visual stimulus at some particular tilt (vertical, horizontal, 25º, etc.)—while it looks flat in this image, these pinwheels actually take a 3D convoluted worm tunnel shape. Line orientation in 3D space, however, remains strangely understudied. Might any sub-population of these line-preference neurons, or some added context, enable discrimination of line preference in the full 3D space? It seems more likely, though, that 3D line orientation is added higher up, once some information has been gleaned. The black lines divide ocular dominance zones (left vs. right eyes).*

*Image taken from:*
*Author: Liu Xiaochen, Robinson Peter A. Title: Analytic Model for Feature Maps in the Primary Visual Cortex. Journaal: Frontiers in Computational Neuroscience. Volume 16. Year 2022. Url: https://www.frontiersin.org/articles/10.3389/fncom.2022.659316. DOI: 10.3389/fncom.2022.659316. ISSN=1662-5188*

*Abstract: A compact analytic model is proposed to describe the combined orientation preference (OP) and ocular dominance (OD) features of simple cells and their mutual constraints on the spatial layout of the combined OP-OD map in the primary visual cortex (V1). This model consists of three parts: (i) an anisotropic Laplacian (AL) operator that represents the local neural sensitivity to the orientation of visual inputs; and (ii) obtain a receptive field (RF) operator that models the anisotropic spatial projection from nearby neurons to a given V1 cell over scales of a few tenths of a millimeter and combines with the AL operator to give an overall OP operator; and (iii) a map that describes how the parameters of these operators vary approximately periodically across V1. The parameters of the proposed model maximize the neural response at a given OP with an OP tuning curve fitted to experimental results. It is found that the anisotropy of the AL operator does not significantly affect OP selectivity, which is dominated by the RF anisotropy, consistent with Hubel and Wiesel's original conclusions that orientation tuning width of V1 simple cell is inversely related to the elongation of its RF. A simplified and idealized OP-OD map is then constructed to describe the approximately periodic local OP-OD structure of V1 in a compact form. It is shown explicitly that the OP map can be approximated by retaining its dominant spatial Fourier coefficients, which are shown to suffice to reconstruct its basic spatial structure. Moreover, this representation is a suitable form to analyze observed OP maps compactly and to be used in neural field theory (NFT) for analyzing activity modulated by the OP-OD structure of V1. Application to independently simulated V1 OP structure shows that observed irregularities in the map correspond to a spread of dominant coefficients in a circle in Fourier space. In addition, there is a strong bias toward two perpendicular directions when only a small patch of local map is included. The bias is decreased as the amount of V1 included in the Fourier transform is increased.*

*Image caption text:*
*FIGURE 1. Experimental OP-OD properties. (A) Combined OP-OD map of macaque monkey, adapted from Blasdel (1992). The borders of OD stripes are shown in solid black, and singularities (pinwheel centers) are labeled by white stars. Oriented color bars indicate different OPs. The blue and red circles outline examples of positive and negative OP pinwheels, and the white rectangle outlines a linear zone. (B) Experimental orientation tuning curve, adapted from Swindale (1998). The preferred orientation angle is around 90°. The dots are the data points, and the solid curve is the fitted tuning curve using a von Mises function.*

*Pinwheel image and orientation curve credits, respectively:*
*Blasdel, G. G. (1992). Orientation selectivity, preference, and continuity in monkey striate cortex. J. Neurosci. 12, 3139–3161. doi: 10.1523/JNEUROSCI.12-08-03139.1992.*
*Swindale, N. V. (1998). Orientation tuning curves: Empirical description and estimation of parameters. Biol. Cybern. 78, 45–56. doi: 10.1007/s004220050411.*

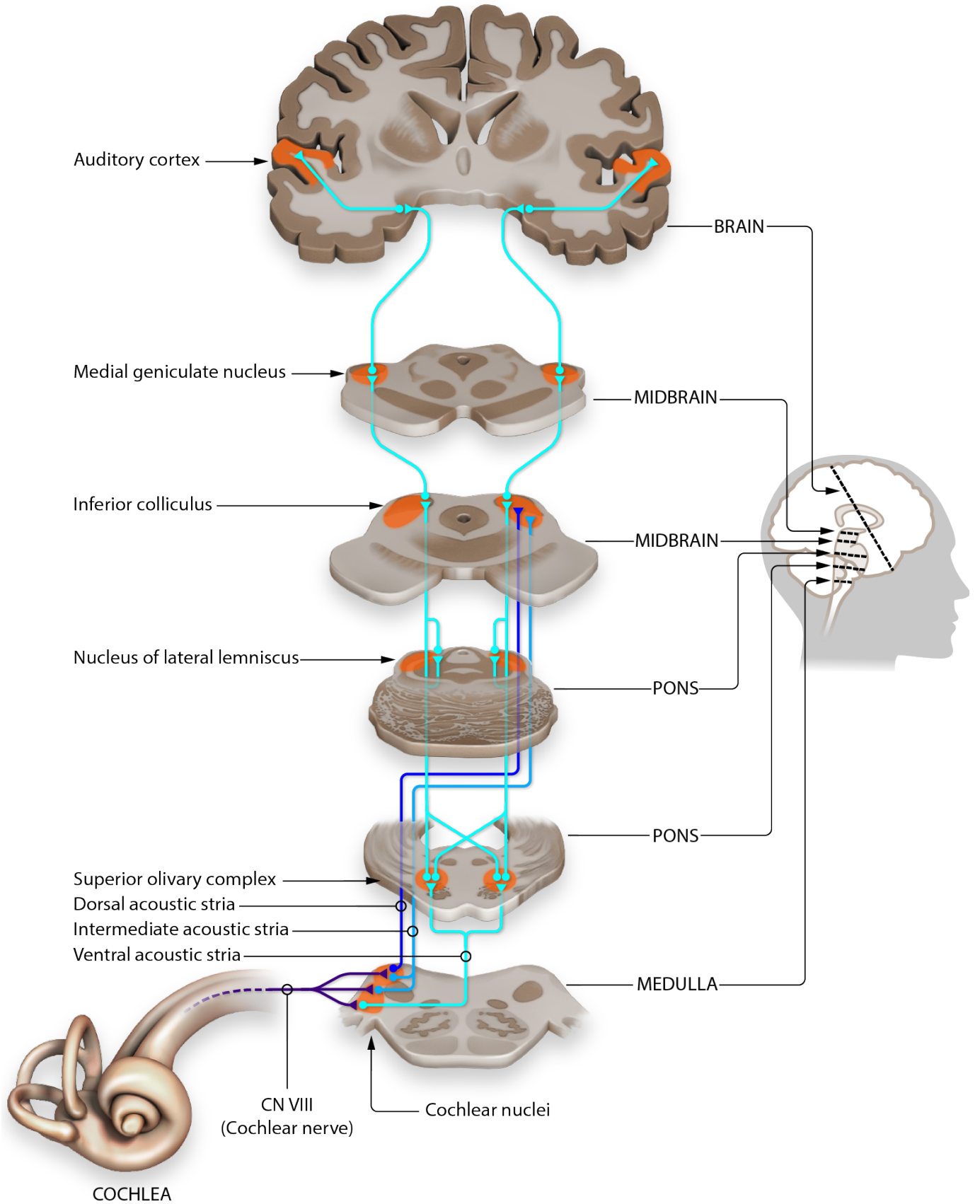


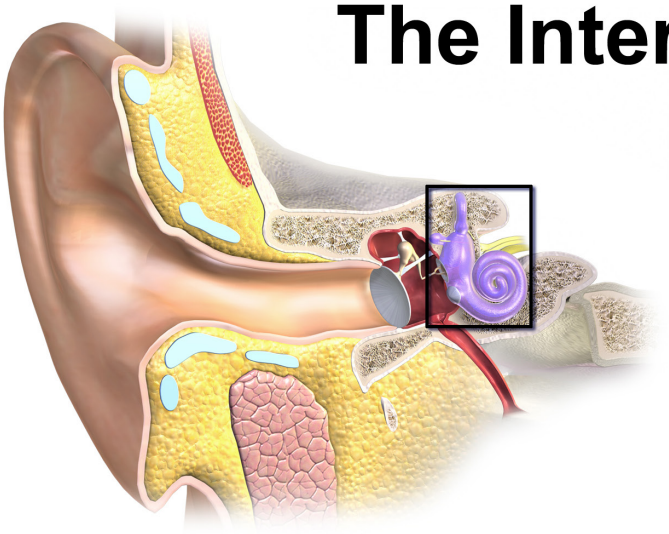

# THE AUDITORY PATH TO THE CEREBRAL CORTEX

## AUDIO'S PATH TO THE CEREBRUM (AND CEREBELLUM)

*Audio has a lot of 'layovers' in the brainstem before reaching the auditory and then prefrontal cortices—cochlear nuclei, uperior olives, inferior colliculi, medial geniculate nuclei of the thalami. Not shown, the cerebellum also gets three major audio collaterals from this path—from the cochlear nuclei, inferior colliculi, and auditory cortex.*

*One of the best books I've ever read is 'The Physics of Speech,' by Daniel Fry (1979). It explores* ***timbre*** *in depth, showing why different vowels (sung at same frequency/amplitude) and disparate instruments (like flute and oboe) sound so qualitatively different. His exploration of fundamentals and formants (overtones) opens a whole world unknown to most.*


Auditory cortex
BRAIN
Medial geniculate nucleus
MIDBRAIN
Inferior colliculus
MIDBRAIN
Nucleus of lateral lemniscus
PONS
PONS
Superior olivary complex
Dorsal acoustic stria
Intermediate acoustic stria
Ventral acoustic stria
MEDULLA
CN VIII
(Cochlear nerve)
Cochlear nuclei
COCHLEA



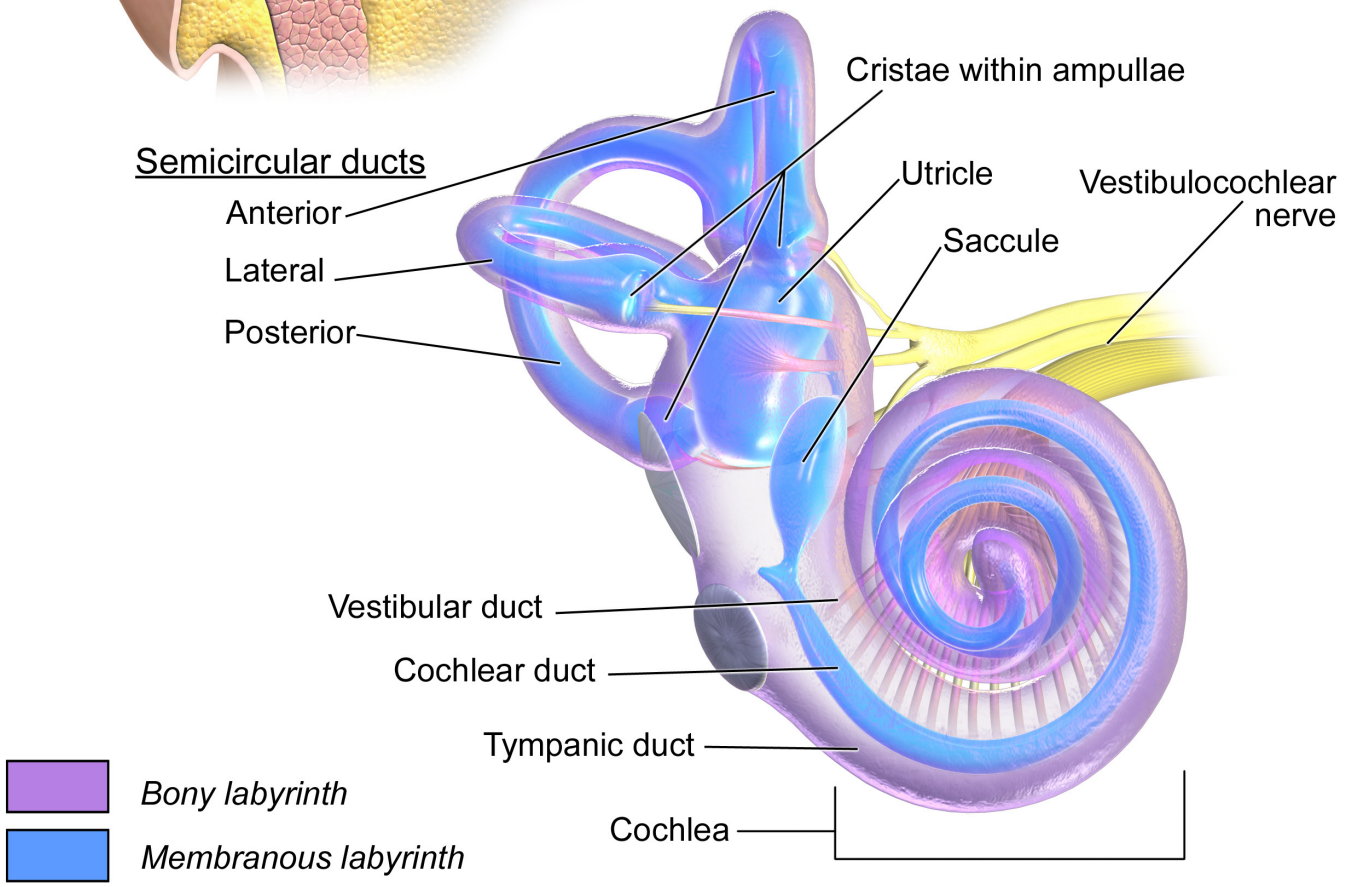
# The Internal Ear

## FACING: COMPRESSIONS/RAREFACTIONS

*Facing: the pulses of mechanical sound can be symbolized in a sine wave drawing, each peak showing compression.*

*Facing, middle blue image: Cochlear stereocilia are like microphones, turning mechanical variations to electrical.*

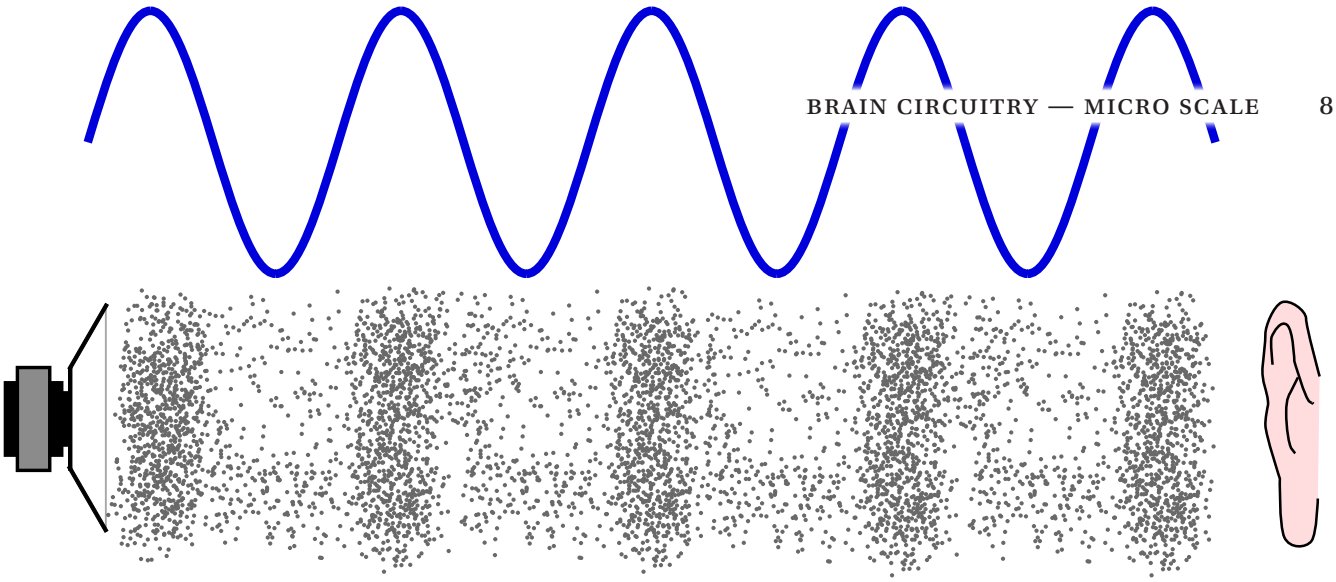
*Upper image credit: Pluke, CC0, via Wikimedia Commons.*
*Blue image credit: Public domain.*

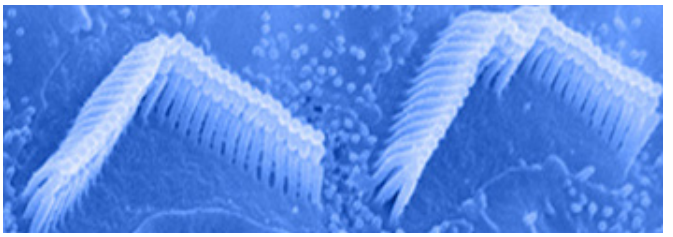



## THE AUDITORY SYSTEM IS COUPLED WITH THE VESTIBULAR (INERTIAL) SYSTEM

*The semicircular canals handle rotational movement starts and stops (rotational forces), whether pitch, roll, or yaw. The otolith, composed of utricle and saccule, handle translational (linear) movement starts and stops (accelerations/decelerations), gravity, and head direction (in the sense of, degree of pitch or roll [but not yaw] of head). I think audio is represented as 'vibrating' the rings (in representational space), while inertia is represented by a more violent 'throwing' of the rings. While 'vibes' and 'throw' share the same sensory organ—the inner ear—they may also share a similar conscious 'depiction mechanism'—bottom-up perturbations to the sampling locations (context rings) the PFC is asking for content at for triggering full 3D schema completion understanding. It might actually be top-down drawing vibes/throw, though.*

*Image credit: BruceBlaus. When using this image in external sources it can be cited as:Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436., CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons.*

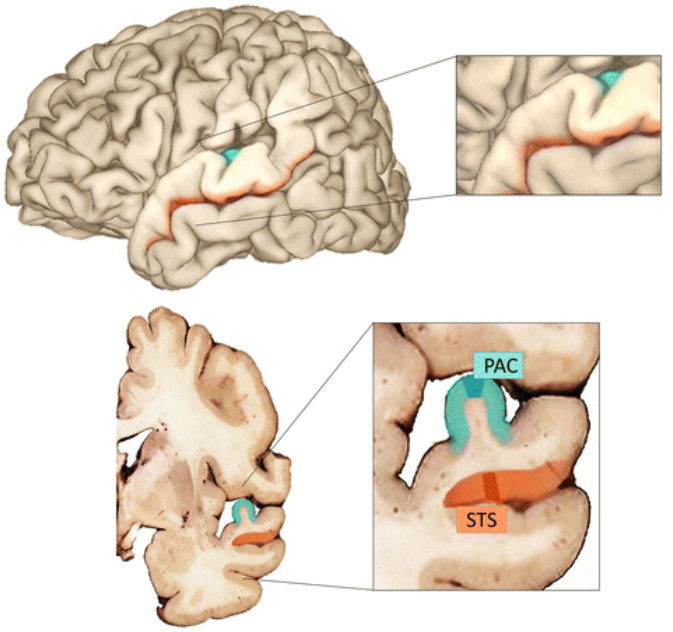




## PRIMARY AUDITORY CORTEX LOCATION

*This image helps you see that the forcep holding back brain in right image isn't trying to illuminate the insula, but rather the bunched up 'Primary Auditory Cortex' in the brain, but not so interior as to reach the insula. STS is 'Superior Temporal Sulcus,' an audio-visual integrator.*

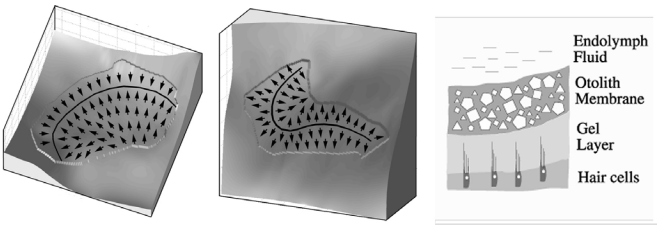
*Image credit: Bradley P. Ander, Nicole Barger, Boryana Stamova, Frank R. Sharp and Cynthia M. Schumann, CC BY 4.0 <https://creativecommons.org/licenses/by/4.0>, via Wikimedia Commons.*




## OTOLITH (UTRICLE AND SACCULE)

*The utricle, shown on left, is fairly horizontal in plane. The saccule, shown to the right of that, is fairly vertical.*

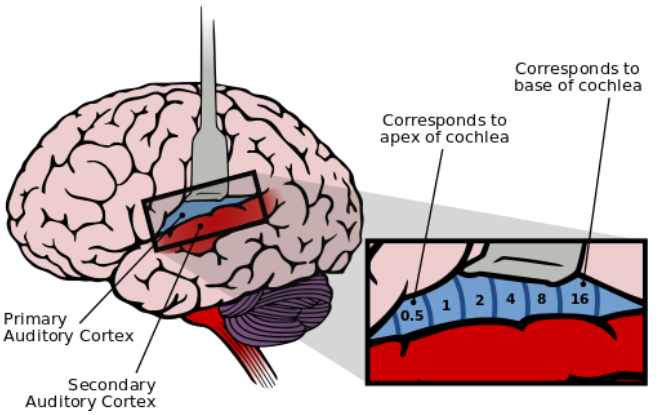
*Image credit: Thomas.haslwanter, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons.*




## FREQUENCY LAYOUT OF AUDIO CORTEX

*In this image, the 0.5 to 16 kHz audio range shown on audio cortex. It isn't quite this perfect though in reality.*

*Image credit: Chittka L, Brockmann, CC BY-SA 2.5 <https://creativecommons.org/licenses/by-sa/2.5>, via Wikimedia Commons.*



# THE SOMATOSENSORY PATH TO THE CEREBRAL CORTEX

## BELOW: PACINIAN CORPUSLES

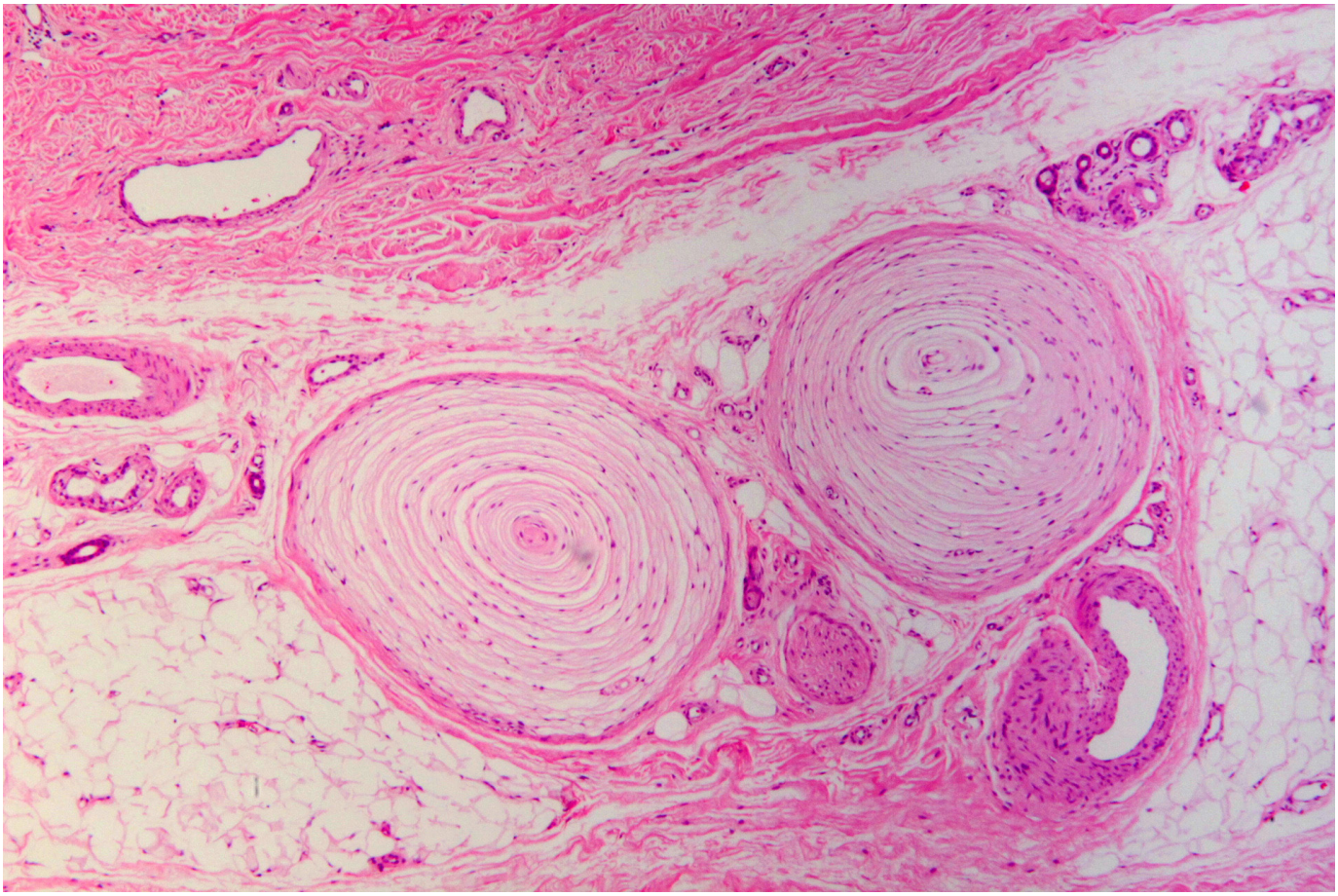
*Vibration and pressure sensors help differentiate texture types. And, in the pancreas, they may enable 'body-feel' of low frequency sound (interesting because it would be a case of sound coming through the somatosensory cortex).*

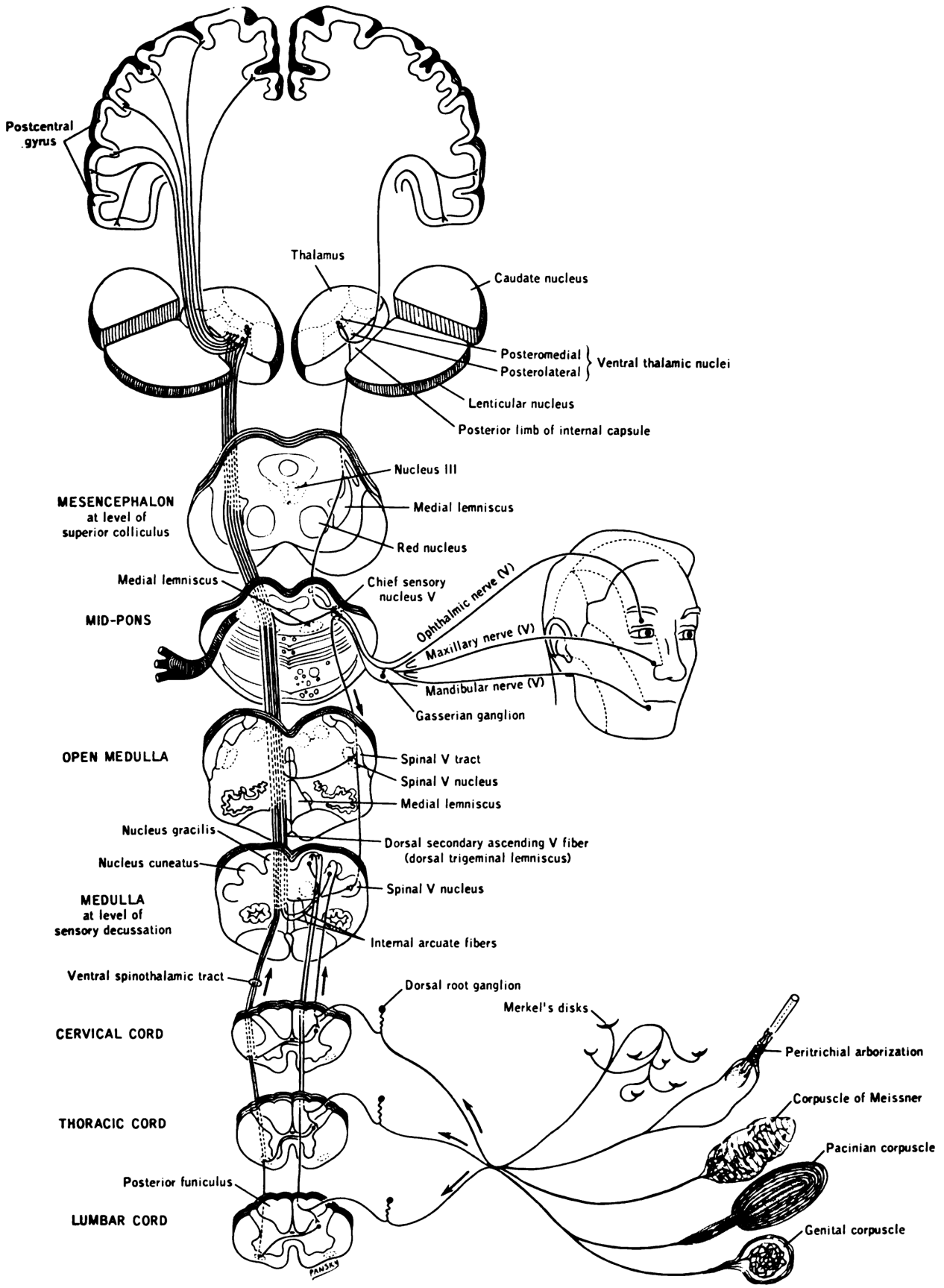
*Image credit: Patho, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons.*

## FACING: ASCENDING SOMATOSENSORY

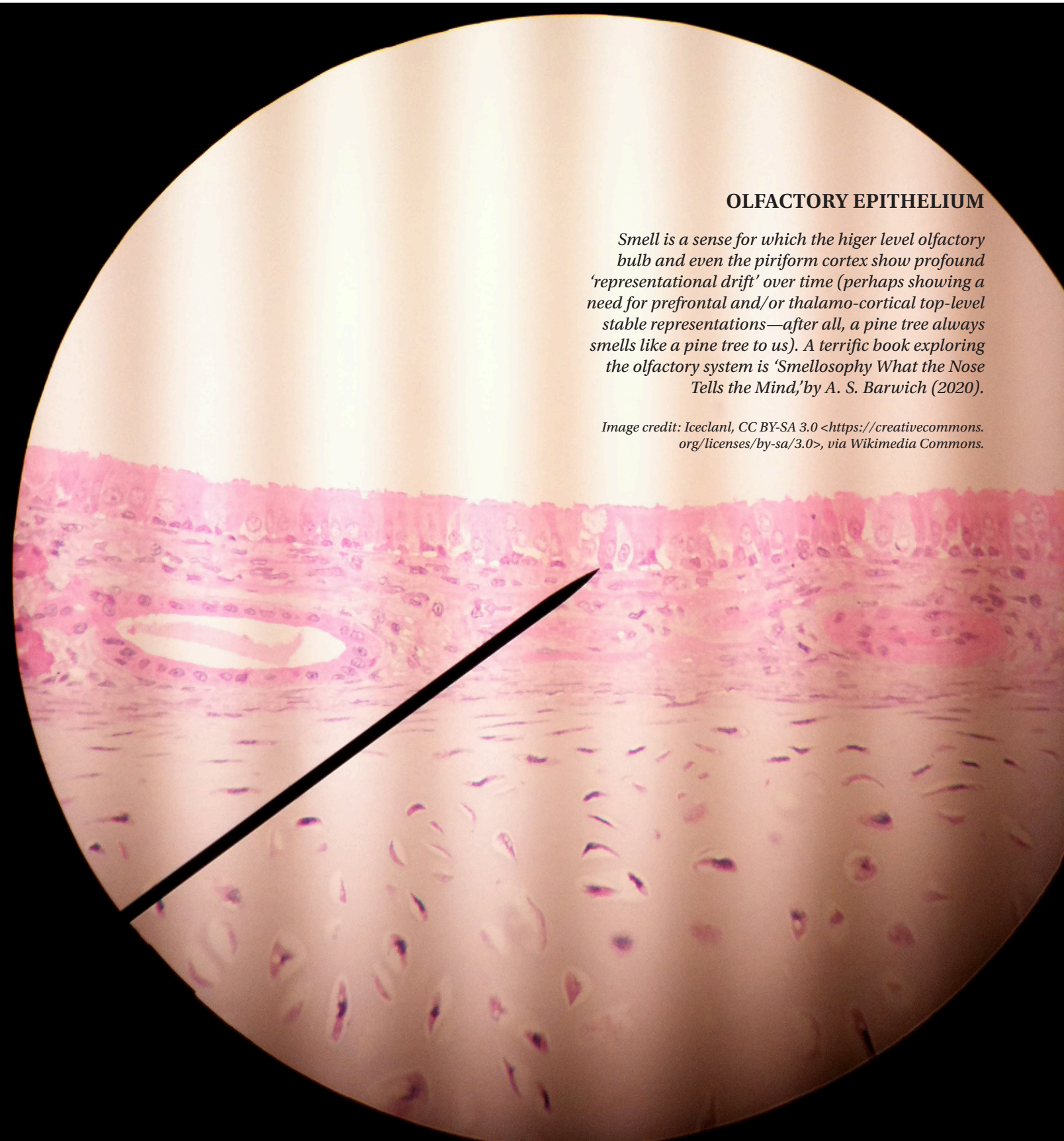
*Touch sensations merely 'indent' upon rings (for duration of force), the 3D location of the touch attracts the rings (near-instantly) or is 'carried' by ring flow in the fusing schema. Touches can be given enlarged mental imagery.*

*Image credit: House, Earl Lawrence. Pansky, Ben., Public domain, via Wikimedia Commons.*



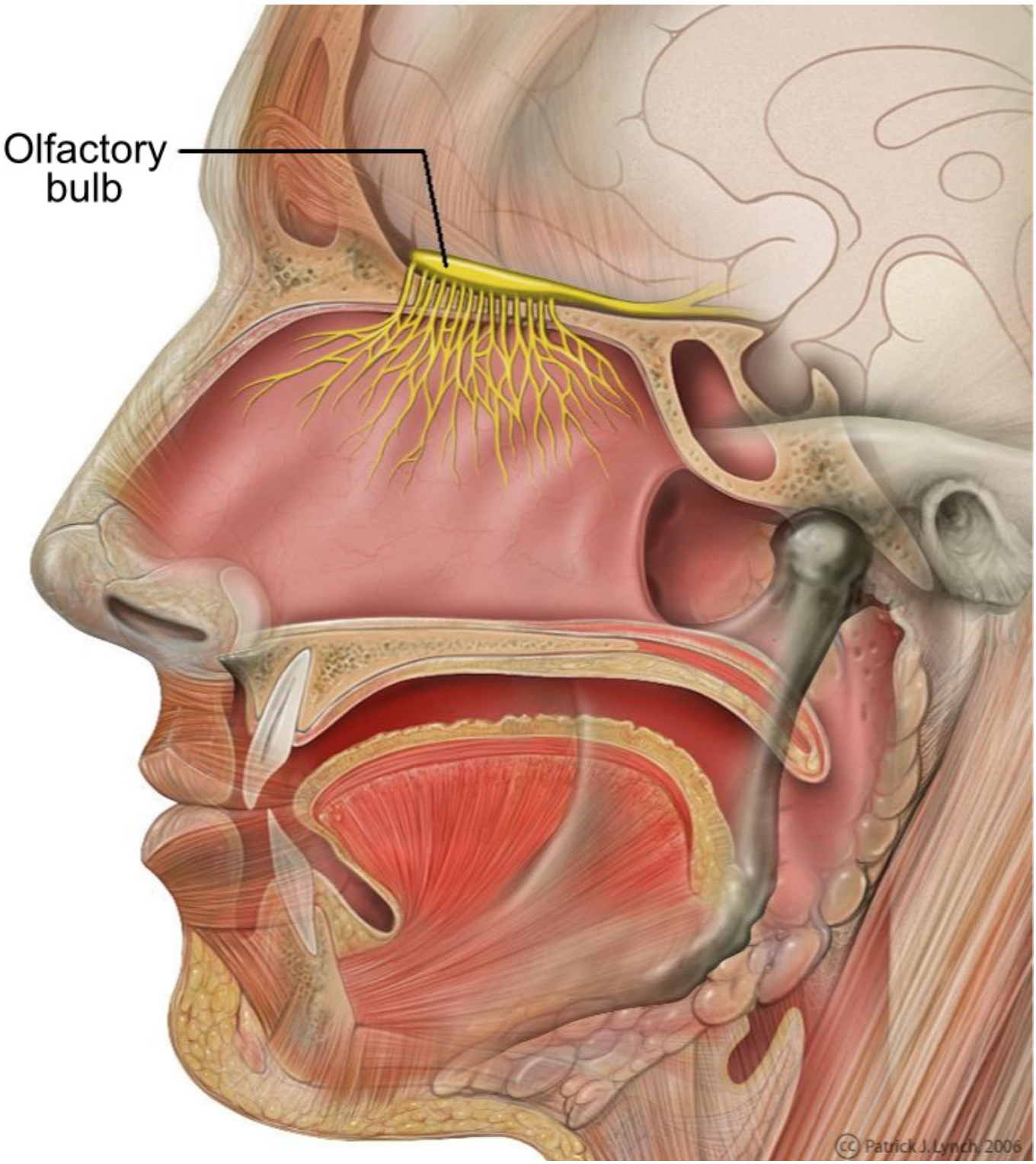

Postcentral gyrus
Thalamus
Caudate nucleus
Posteromedial
Posterolateral
Ventral thalamic nuclei
Lenticular nucleus
Posterior limb of internal capsule
Nucleus III
MESENCEPHALON at level of superior colliculus
Medial lemniscus
Red nucleus
Medial lemniscus
Chief sensory nucleus V
MID-PONS
Ophthalmic nerve (V)
Maxillary nerve (V)
Mandibular nerve (V)
Gasserian ganglion
OPEN MEDULLA
Spinal V tract
Spinal V nucleus
Medial lemniscus
Nucleus gracilis
Dorsal secondary ascending V fiber (dorsal trigeminal lemniscus)
Nucleus cuneatus
Spinal V nucleus
MEDULLA at level of sensory decussation
Internal arcuate fibers
Ventral spinothalamic tract
Dorsal root ganglion
Merkel's disks
CERVICAL CORD
Peritrichial arborization
Corpuscle of Meissner
THORACIC CORD
Pacinian corpuscle
Posterior funiculus
LUMBAR CORD
Genital corpuscle
PANSKY

# THE OLFACTORY PATH TO THE CEREBRAL CORTEX



**OLFACTORY EPITHELIUM**

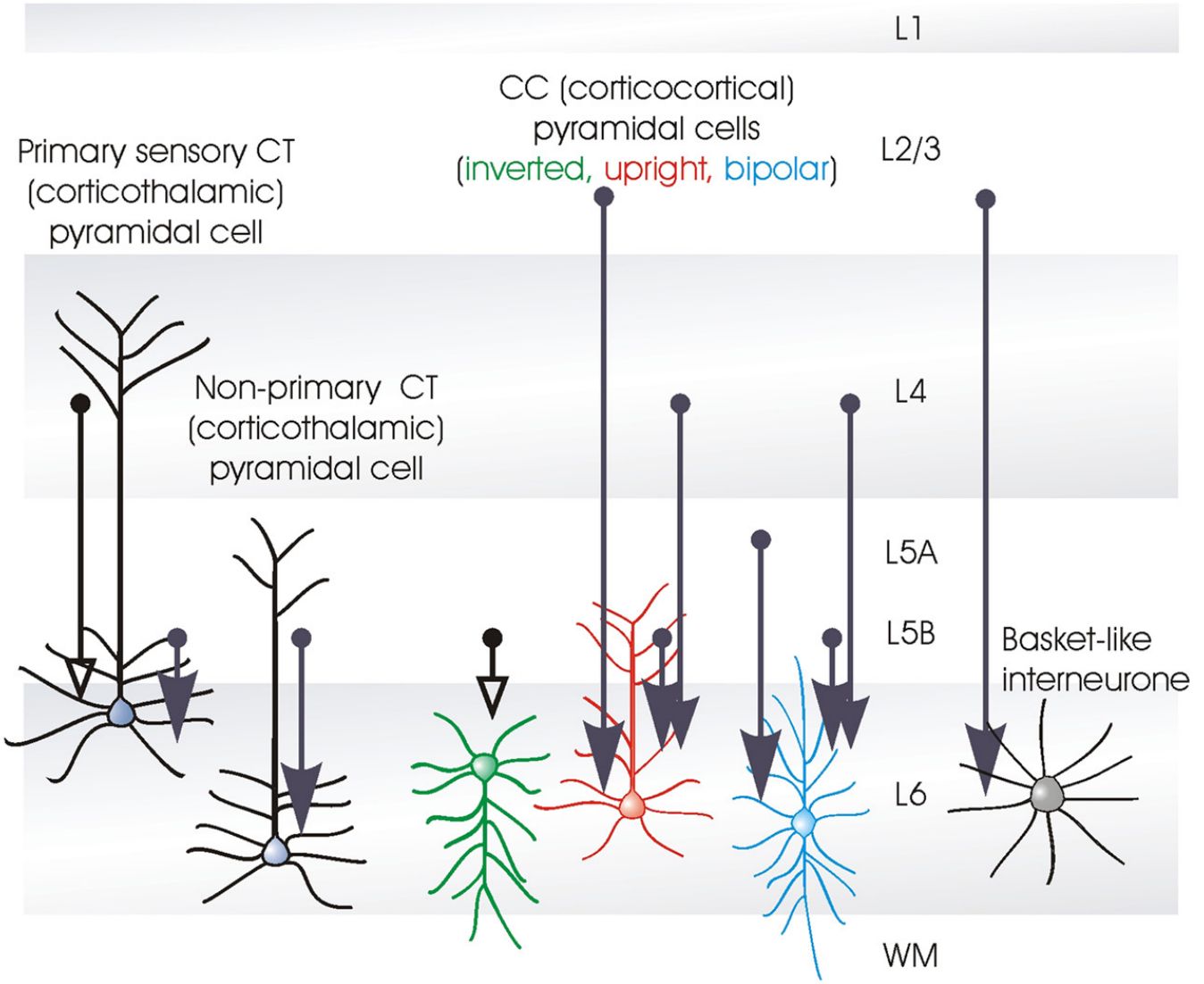
*Smell is a sense for which the higer level olfactory bulb and even the piriform cortex show profound 'representational drift' over time (perhaps showing a need for prefrontal and/or thalamo-cortical top-level stable representations—after all, a pine tree always smells like a pine tree to us). A terrific book exploring the olfactory system is 'Smellosophy What the Nose Tells the Mind,'by A. S. Barwich (2020).*




**OLFACTORY BULB**

*After following the path of smell to the olfactory bulb (which has inputs from higher-level brain regions), there are paths to the amygdala (by way of the primary olfactory cortex's 'piriform cortex'), hippocampus, and orbitofrontal cortex.*

*Patrick J. Lynch, medical illustrator. (labeled by was_a_bee), CC BY 2.5 <https://creativecommons.org/licenses/by/2.5>, via Wikimedia Commons.*

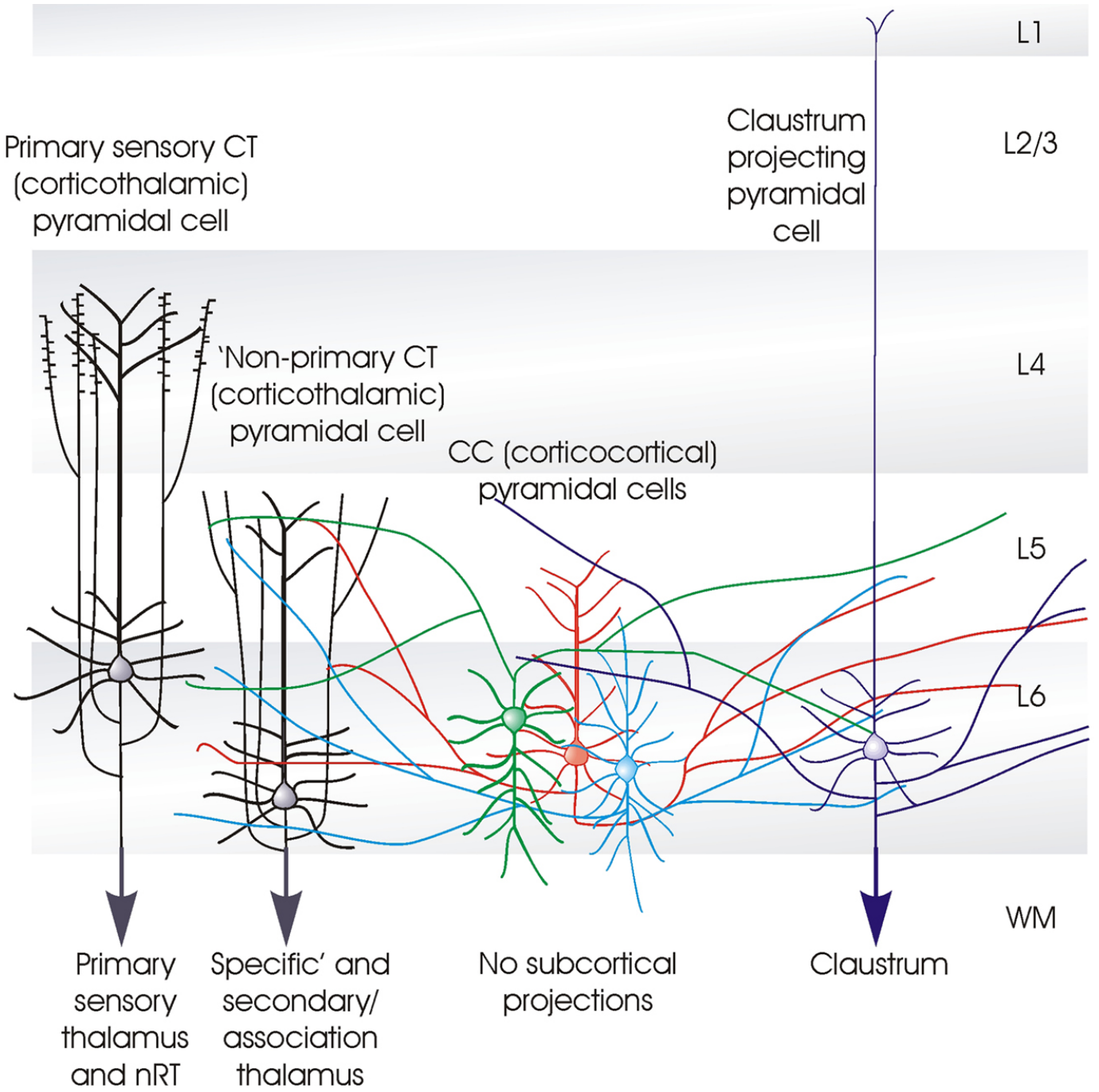



**INPUTS TO LAYER SIX OF THE CEREBRAL CORTEX**

*Some consider layer five pyramidal neurons of associational/prefrontal cortex to be a possible location for consciousness. It sits as a sort of 'continental divide' between arising and descending processes. Such proponents would likely agree this is a bit of a simplification, as there may be more nuance to it. Stuart Hameroff is a proponent of the idea that quantum processes are orchestrated by the brain to allow an emergent consciousness to have control over the individual parts necessary to alter the motor output of the entire organism. Kevin Mitchell has suggested that quantum might not be about the tiny scale, but about an uncertain future always taking a span of say one second to 'concretize,' and that the brain has learned to steer this to enable conscious agency. But he also proposes that there may be a mechanical embedding within organisms that enacts responses according to malleable goals with the continual inflow of information (I personally like this latter idea the best, although why there is experience at all seems mysterious enough to keep looking at quantum).*

*Jeff Hawkins and Vernon Mountcastle explore the idea that there are 'thousands of brains' (columns) in the cerebral cortex which receive input from a small receptive field and particular variety (visual, auditory, touch). The organism can move these sensors and observe the changes in information pertaining to an attended object—like the analogy of us being robots with moveable sensors to build a model of self, objects, and generally the entire world—with agency as the switch of output, given the decoupled observation of input, in the light of changeable goals, and with dynamic arousal level.*

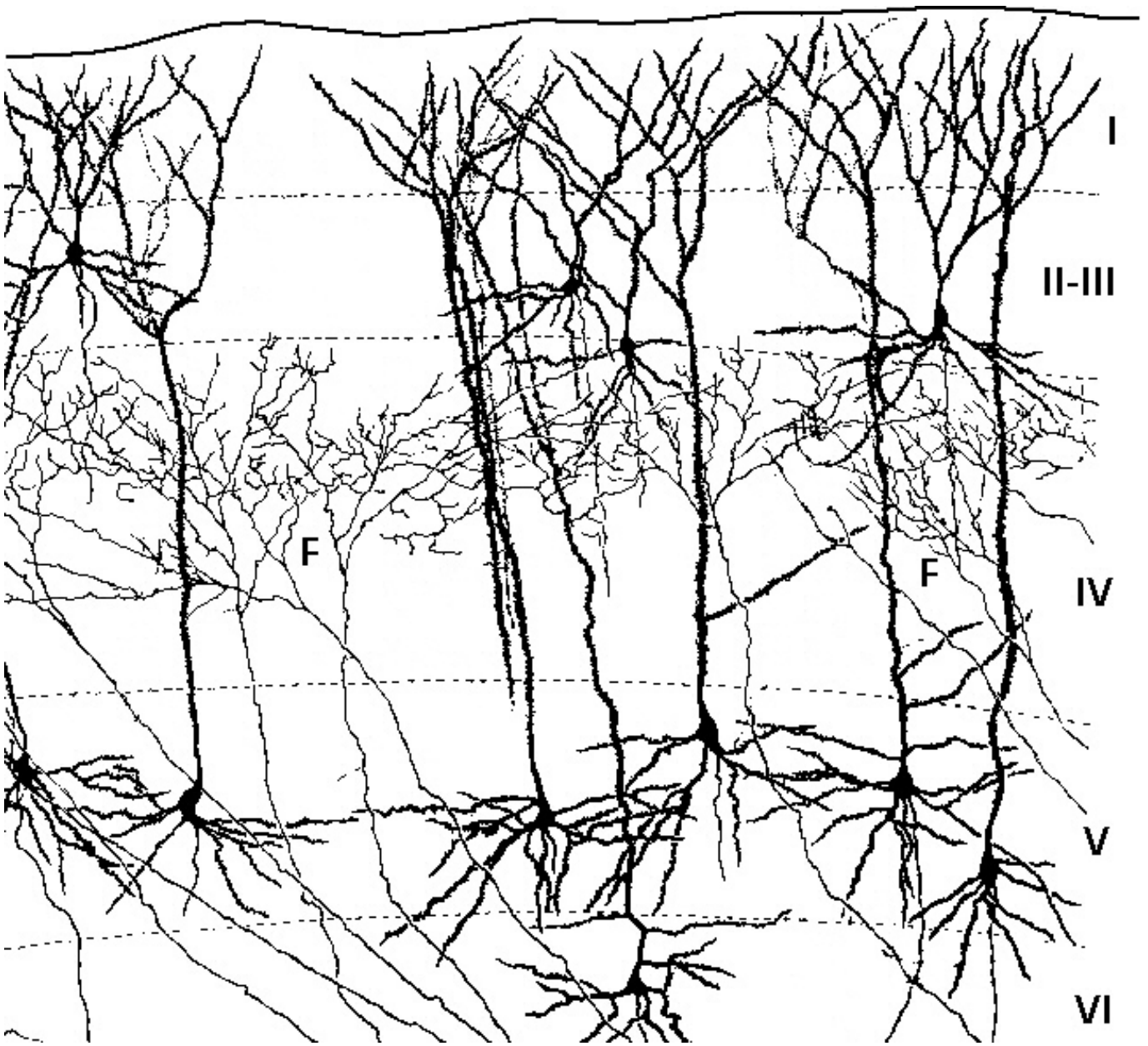
*Image credit on page 81.*




## OUTPUTS FROM LAYER FIVE/SIX OF THE CEREBRAL CORTEX

*Layer five neurons from sensorimotor cortex send out motor commands that ultimately reach the muscles of the body. Studies led by Eric Miller/MillerLabMIT[1] have indicated that the 'start-up' buffer build-up to consciousness, over a few seconds or less, may have to do with the task of broadcasting 'same-page-ness' to a large enough collection of neurons in associational cortex areas. In other words, with anesthesia, signals can still get to the cortex, but there is not self-sustaining engagement/cooperation to map content to context, derive meaning, and drive response. Image credit on page 81.*

1 Institute, P. (2023). Anesthesia blocks sensation by cutting off communication within the cortex. Picower Institute. https://picower.mit.edu/news/anesthesia-blocks-sensation-cutting-communication-within-cortex.




location in 3D space?) or even the three modes of rotation mentioned (horizontal, sagittal, coronal) of stator and rotor "rings" which seem to do periodic alignment work?

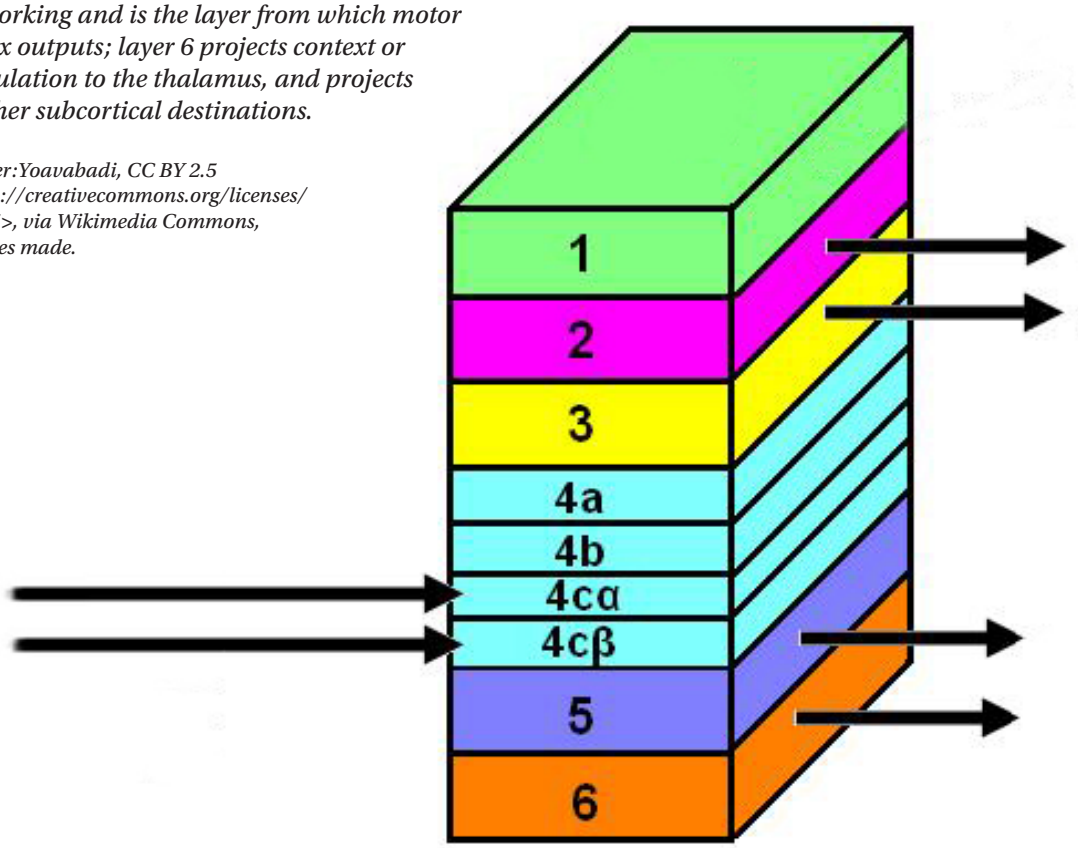
**Pyramidal Cells of the Cerebral Cortex**

A key feature of the cerebral cortex is the presence of certain tall pyramidal cells with bodies and basal dendrites in layer 5 of the cerebral cortex, but which have a single upward dendrite that branches out apically in layers 2-3 (or perhaps, 1-3, as in the image above — Mavavf, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons). The basal dendrites interact with layer 5; the apical

## LAYERS OF THE CEREBRAL CORTEX

*Inputs to the cerebrum usually come to layer 4; layers 2/3 and 5 have significant outward networking and is the layer from which motor cortex outputs; layer 6 projects context or modulation to the thalamus, and projects to other subcortical destinations.*



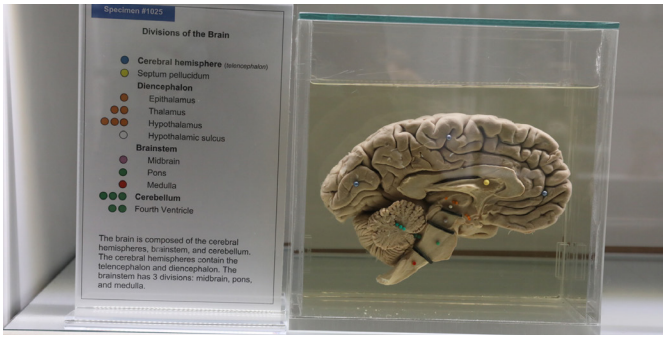



reach up to layer 2,3. Both of these are layers with a decent amount of horizontal interconnections. One wonders what function, in association cortices, these two 'meshes' serve. In lower cortices, like V1, layer 2/3 connects cells of a similar line orientation preference. But as I keep emphatically stating, from phenomenology, there are these 3D schemas of information getting aligned with rings, and in general, with the entire bank of rings, so I have to wonder if higher cortex layer 2/3 is facilitating this. Is the fundamental computation of the cerebral column just one of comparing lots of copies of a single (broadcast to be learned?) bank? I maintain that any region of cortex participating in conscious isomorphy is interacting with and using this bank. And yes, to be clear, it appears possible for the prefrontal cortex to judge 3D just from the flat visual field, even without the bank. But I've never noticed consciousness siloed off from this bank (when it was observable).

### Von Economo "Corkscrew" Cells

These are found in the insular and cingulate cortex. The insula is said to fire on a pretty regular basis. Could it serve some special function? Von Economo cells come in a couple different varieties — spindle cells (dendrites just up and down) and helical cells (the dendrites actually look like little corkscrews!). Could either of these have some unique function? Would vibrating in a spiral have

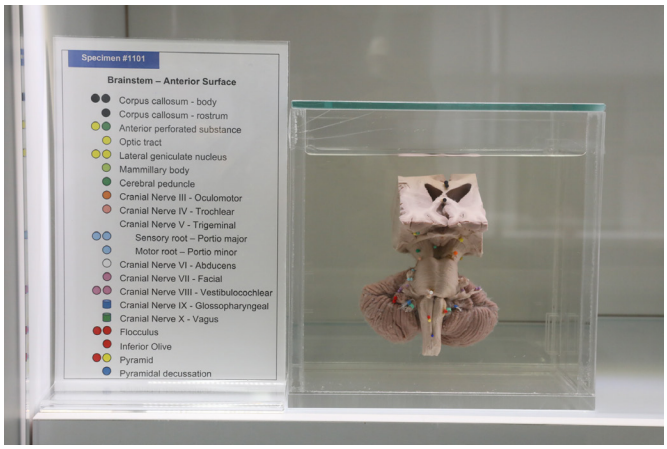
some ability, consciousness-wise, even if it were just helping with vibrations of rings? Probably not, as consciousness doesn't seem to arise from physical jostles or even EM jostles, but instead from meaning. But I won't rule out anything as-yet.

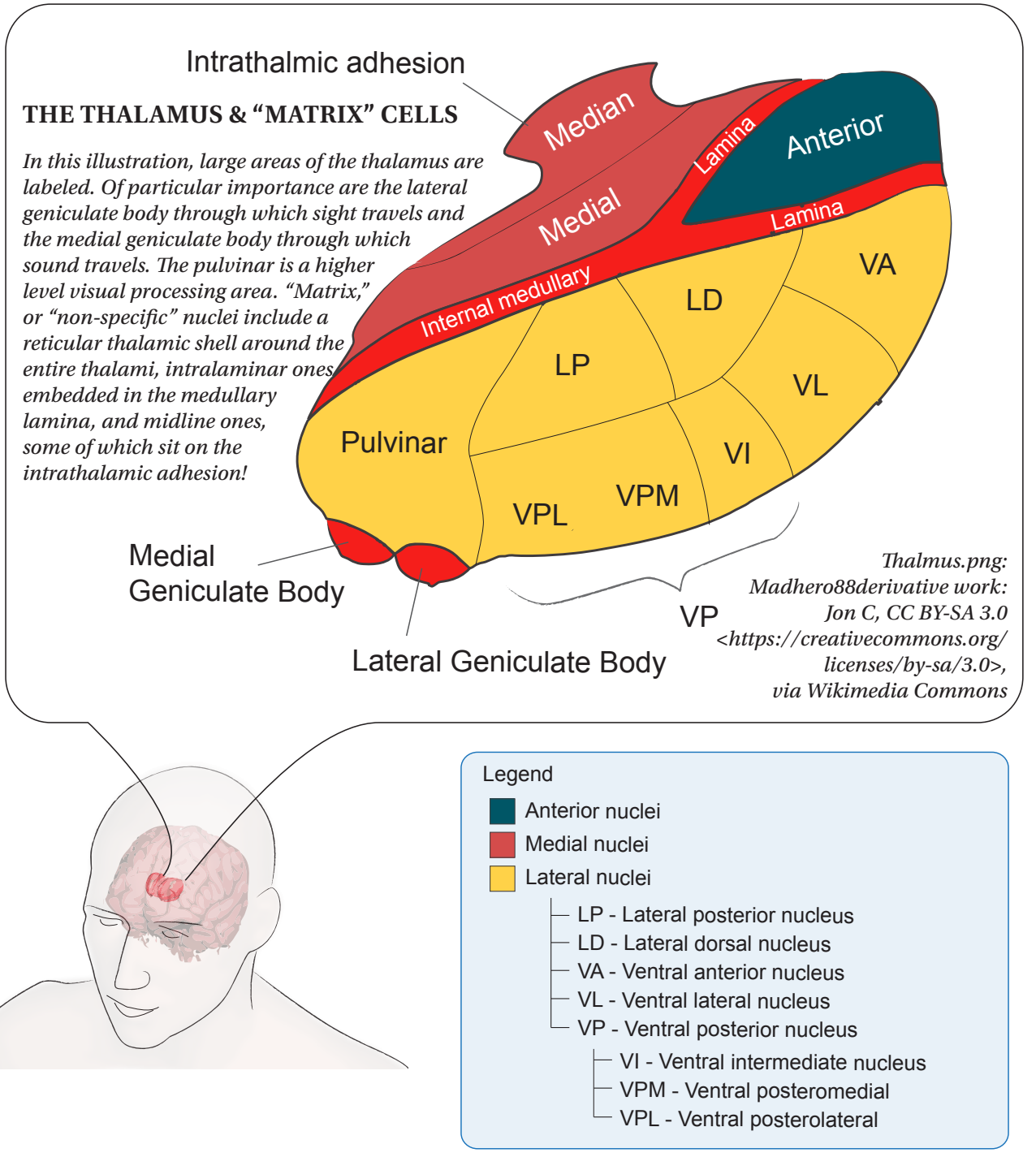



These helical von Economo dendrites somewhat resemble an actual corkscrew, as pictured below (Gixie, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons). The insula gets multi-modal inputs, so it could be an important hub. The right anterior insula is implicated in the salience network, and may act as a sort of switch between the default mode network (imagination schema?) and the central executive network (real world schema?)— if so, it could be crucial to the bank/ring tethers that 'hotkey' one between realms.

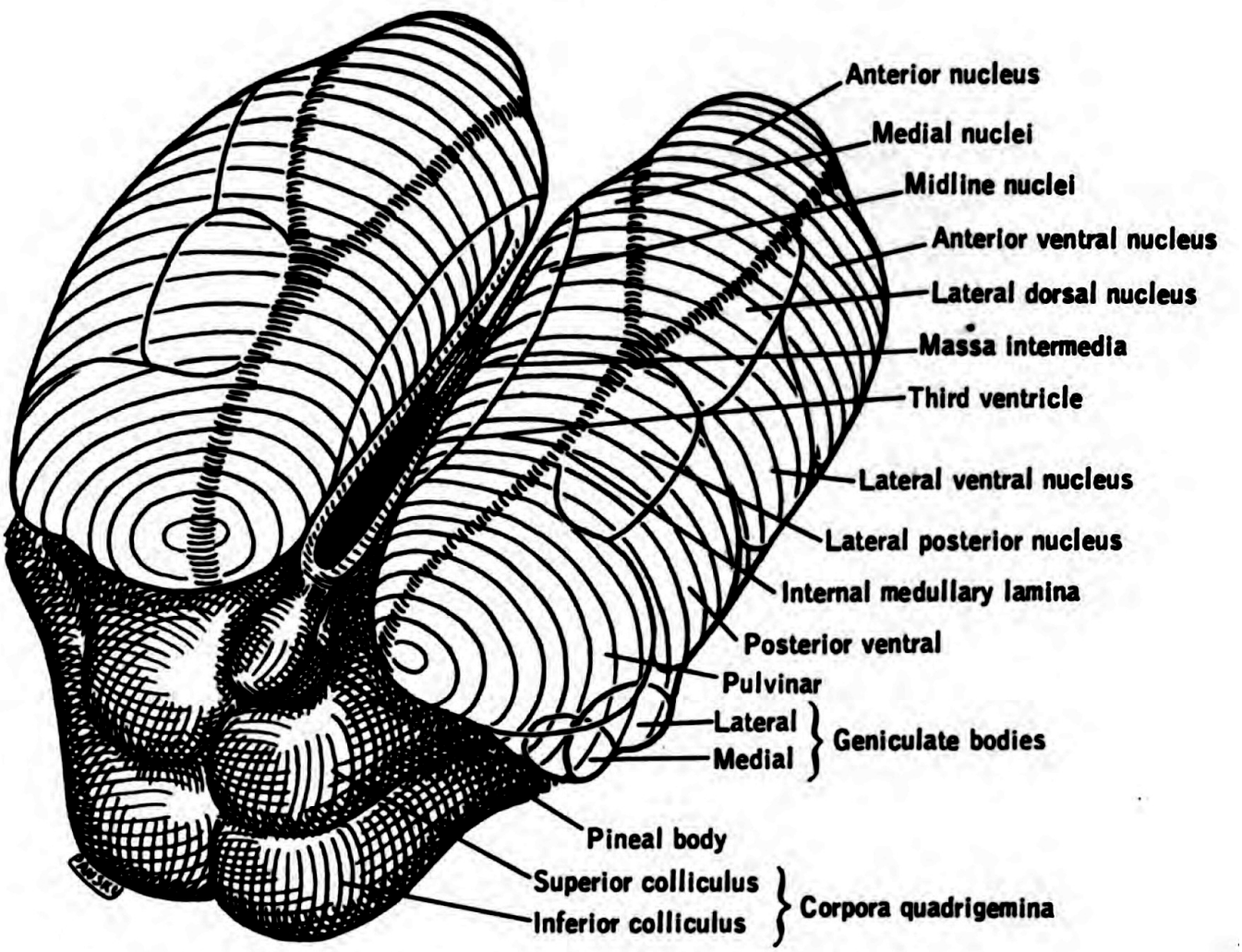
### Nuclei of the Brainstem

A lot goes on in the brainstem (see image below from Buffalo Brain Museum where it is segmented into midbrain, pons, and medulla) — it holds the main circuitry for incoming audio signals, and is a junction between incoming (from the body) and outgoing (muscle commands) info. There are connections with the cerebellum. There is the inferior olive which gets a ton of inputs and may






have a key role in LTD of specific Purkinje cells in the cerebellum. There's the superior colliculus which gets sight and body signals and the inferior colliculus which gets sound information. The superior colliculus causes you to turn your eyes when you see a salient stimulus ("danger!"), and the inferior does the same thing for sound. They're located by the cerebral aqueduct (cerebrospinal

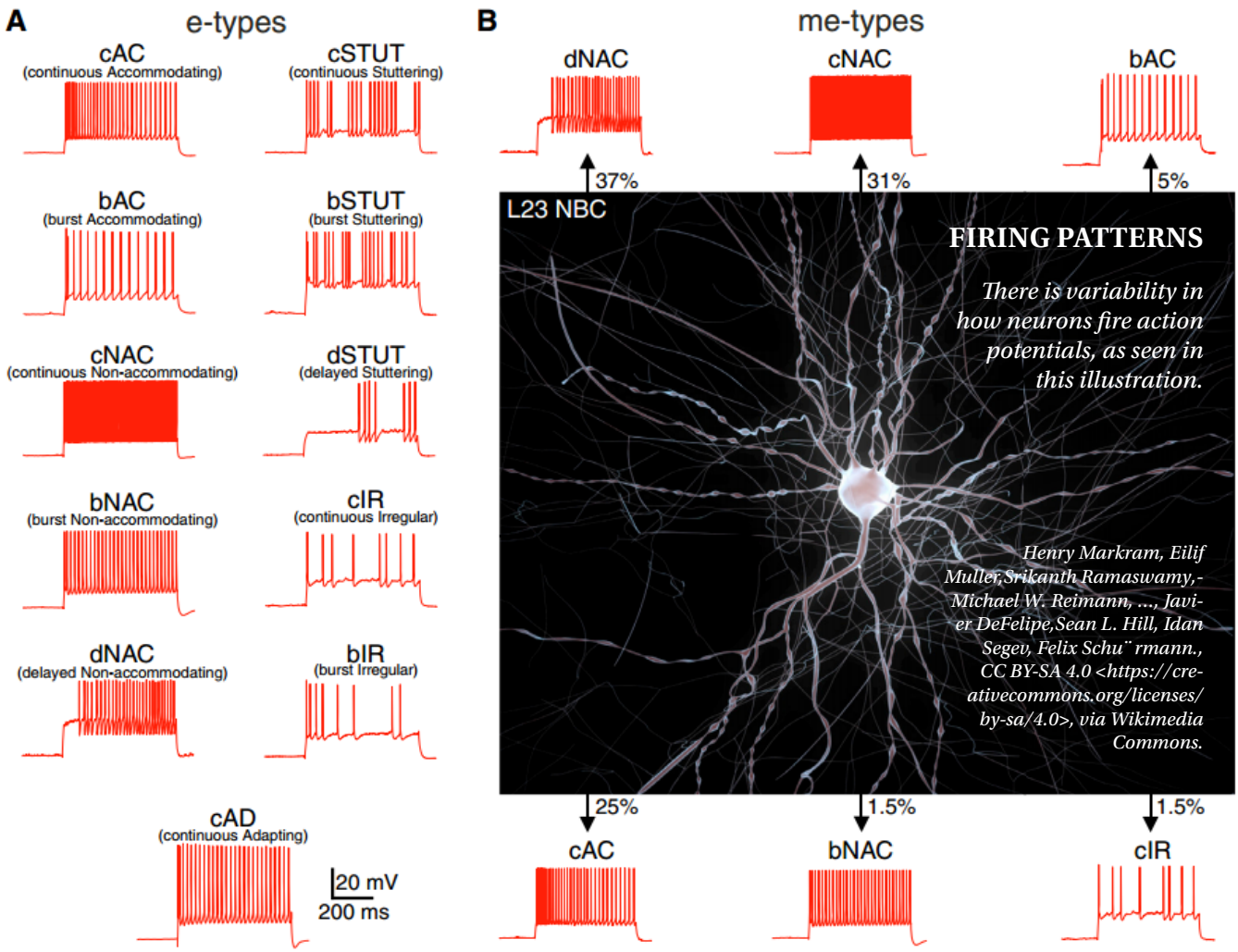


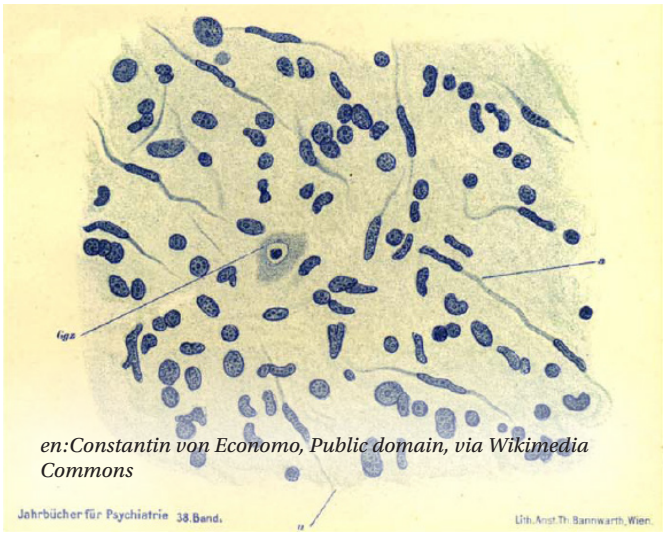

fluid flows very quickly through this constriction in the ventricular system pathway) and are grouped into the corpora quadragemina.

**Matrix Cells**

Part of the ARAS is the cholinergic portion, which feeds the "non-specific nuclei" of the thalami. They communicate adjustment of level of arousal. There's a "reticular thalamic nucleus" around part of the thalami. There are intralaminar nuclei deep within each thalamus. And there are midline nuclei, some of which sit right in the center of the cerebrum, between both thalami, touching both sides, along the interthalamic adhesion.

Two images of the thalamus are provided to help you mentally locate these matrix cells (second image — House, Earl Lawrence. Pansky, Ben., Public domain, via Wikimedia Commons). The two cholinergic nuclei (PPN and LDT) that feed forward to the matrix cells apparently stay on your whole entire life—they are the only nuclei within the ARAS to never go offline during sleep.




*en:Constantin von Economo, Public domain, via Wikimedia Commons*

## Firing Patterns

There are different modes which serve particular functions. In hyperpolarization, bursting can occur (delay, burst, delay, burst). During the off period, incoming signals are shut out (appears to be used in sleep at 4 Hz to keep you from waking up at every noise you hear, and apparently the burst is mapped to your imagination, so that you're never mapping any of the signals to the real world so as to be startled/awakened).

## HIPPOCAMPUS

*Pyramidal cells of the hippocampus are shown in this image.*

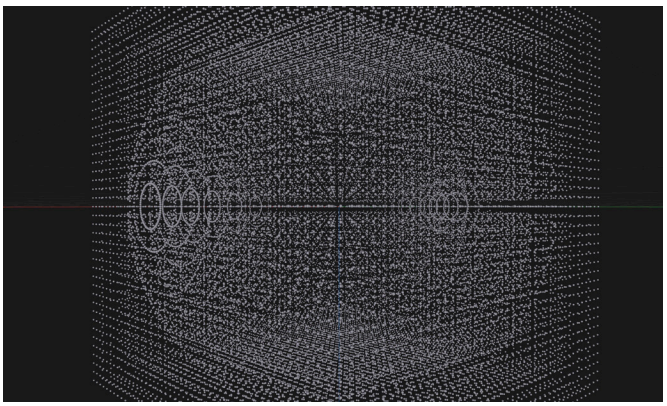
Many exogenous ligands (alcohol, hemp, ketamine) can have a profound effect on consciousness, ostensibly via inducing hyperpolarization and gaps/bursts in wakefulness. Hemp's THC, for example, binds to retrograde CB1 receptors (most others bind to prograde receptors) and 'pinches the end of the neural hose.' So this is thought to slow down the volume of activity, leading to hyperpolarization of the next neuron and gap + burst 'cyclization' of experience into strobes or freeze frames or uncomfortable lags.

CB1 receptors have varying densities across the brain. The hippocampus (image on facing page) is chock full of them; the brainstem has essentially none. Primary cortices have very little; higher, associational cortices have a moderate amount. Substantia nigra (dopamine powerhouse) is loaded, and so is the molecular layer of the cerebellum where Purkinje cell dendrites live (but not the granular layer with all the granule cells). The cingulate cortex is fairly dense, and the globus pallidus internal (the brakes on the brain) has almost as high a density of them (inhibiting the 'brake pedal'?). The frontal lobe also has a higher-than-average density.

Basically, the regions that have a high density of CB1 receptors may get hyperpolarized into a more start-and-stop, jerky operation. Also, as I already mentioned, ketamine has been shown to cause cyclification (gap, burst, gap, burst) of neural firing patterns. It is amazing to see the spike trains of neurons in the retrosplenial cortex before and after ketamine[21]—the change from smooth to cyclic (2 Hz) is plain as day! And you can see how this cyclism could go on to knock certain parts of the brain out-of-sync with each other—possibly the cause of dissociation!

GABA-agonists would seem to have a very similar effect upon conscious experience (dreamy, but possibly also 'staccato-ified' due to hyperpolarization), such as may be induced by barbiturates, phenibut, or the fly agaric mushroom's muscimol (beware its ibotenic acid which is toxic!).

5HT-agonists may have a profoundly different effect on consciousness, possibly enabling 'too much' consciousness rather than 'too little,' as demonstrated by the extra geometries observed.



21 Vesuna, S., Kauvar, I.V., Richman, E. et al. Deep posteromedial cortical rhythm in dissociation. Nature 586, 87–94 (2020). https://doi.org/10.1038/s41586-020-2731-9.

| NEUROTRANSMITTER GROUPED BRAIN RECEPTORS | | | | | | |
|---|---|---|---|---|---|---|
| A: AGONIZE<br>ANT: ANTAGONIZE<br>R: REGULATE<br>RI: REUPTAKE INHIBITOR<br>*RELATIVE ANTAGONIST IN PRESENCE OF THC<br>**SOME ARE DANGEROUS AND/OR PENALIZED** | ADENOSINE | GLUTAMATE | GABA | SEROTONIN 5HT-1A | SEROTONIN 5HT-2A | SEROTONIN 5HT-2C |
| SCHISANDRA | | | | | | ANT |
| GINSENG | | | R | RAISE | | |
| LOTUS APOMORPHINE | | | | A | ANT | |
| LOTUS NUCIFERINE | | | | | ANT | |
| COFFEE | ANT | | | RAISE | | |
| ST JOHN'S WORT | | RI | | RI | | |
| CBD | | | | | | |
| HEMP THC | | LOWER | | | | |
| KETAMINE | | ANT | | | | |
| NITROUS OXIDE | | ANT | | | | |
| BARBITURATE/PHENIBUT | | | A | | | |
| ALCOHOL | | LOWER | RAISE | | | |
| NICOTINE | | | | | | |
| COCA | | | | | | |
| 5-MEO-DMT | | | | A | A | |
| PSILOCIN/LSD | | | | | A | |
| NN-DMT | | | | | | A |
| METH/EPHEDRA | | | | | | |
| HEROIN | | | | | | |

| TARGETED BY VARIOUS EXOGENOUS MOLECULES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DOPAMINE | ANANDAMIDE/2-AG (CANNABINOID CB1) | GLYCINE | HISTAMINE | OPIOIDS (μ) | ACETYLCHOLINE (NICOTINIC) | TRKB (BDNF) | EPINEPHRINE & NOREPINEPHRINE | SIGMA |
| | | | | | | RAISE | | |
| | | | | | R | RAISE | | |
| | | | | | | | | |
| | | | | | | | | |
| RAISE | | | | | | | | |
| RI | | | | | | | RI | |
| | ANT* | | | | | | | |
| RAISE | A | | | | | | | |
| RAISE | | | | | | | | |
| RAISE | | | | RAISE | | | RAISE | |
| RAISE | | | | | | | | |
| RAISE | | RAISE | | RAISE | | | | |
| RAISE | | | | | A | | | |
| RAISE | | | | | | | | |
| | | | | | | | | |
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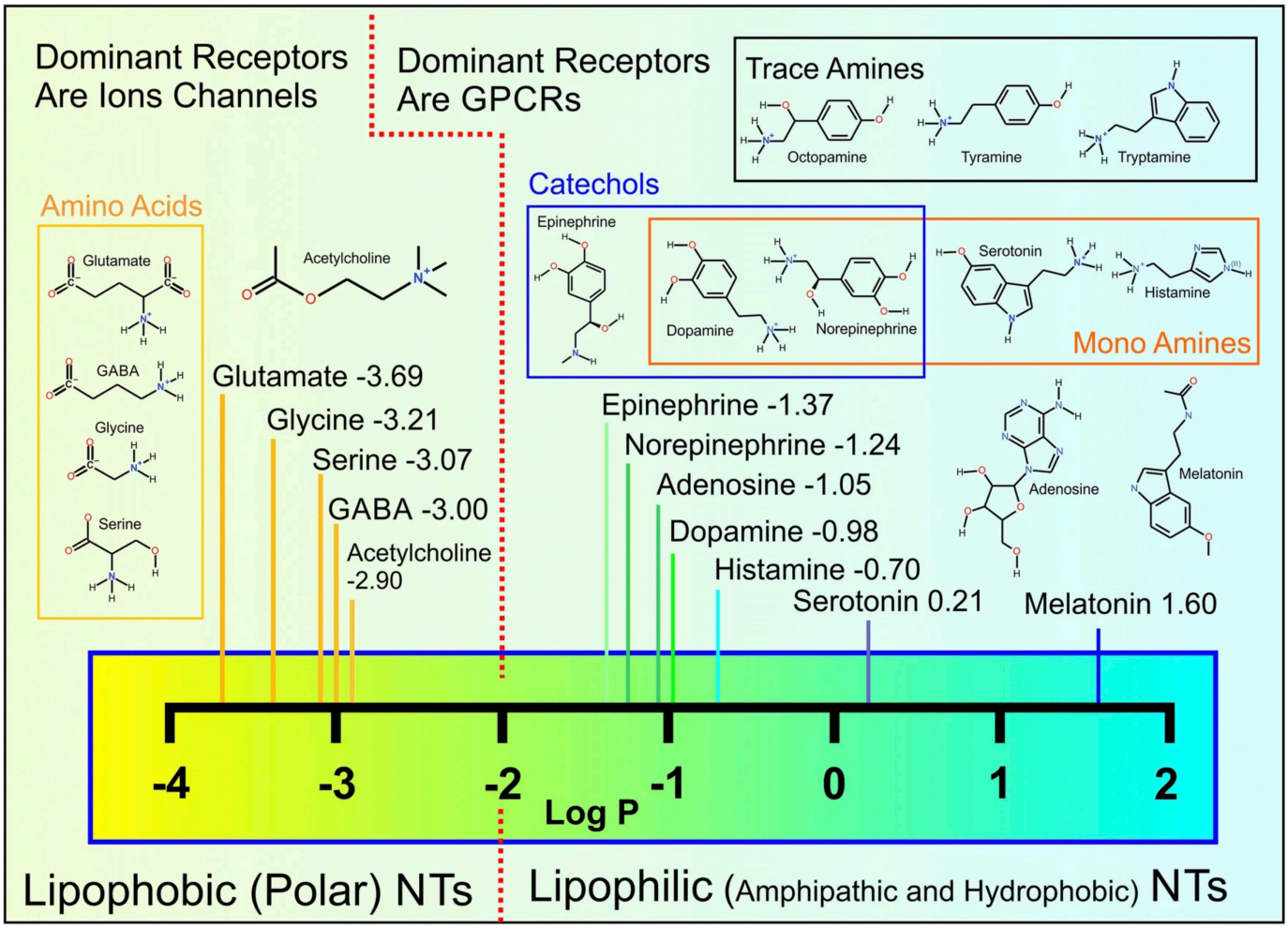
| | | | | | | | | |
| RAISE | | | | | | | | A+ |
| RAISE | | | | A | | | | |



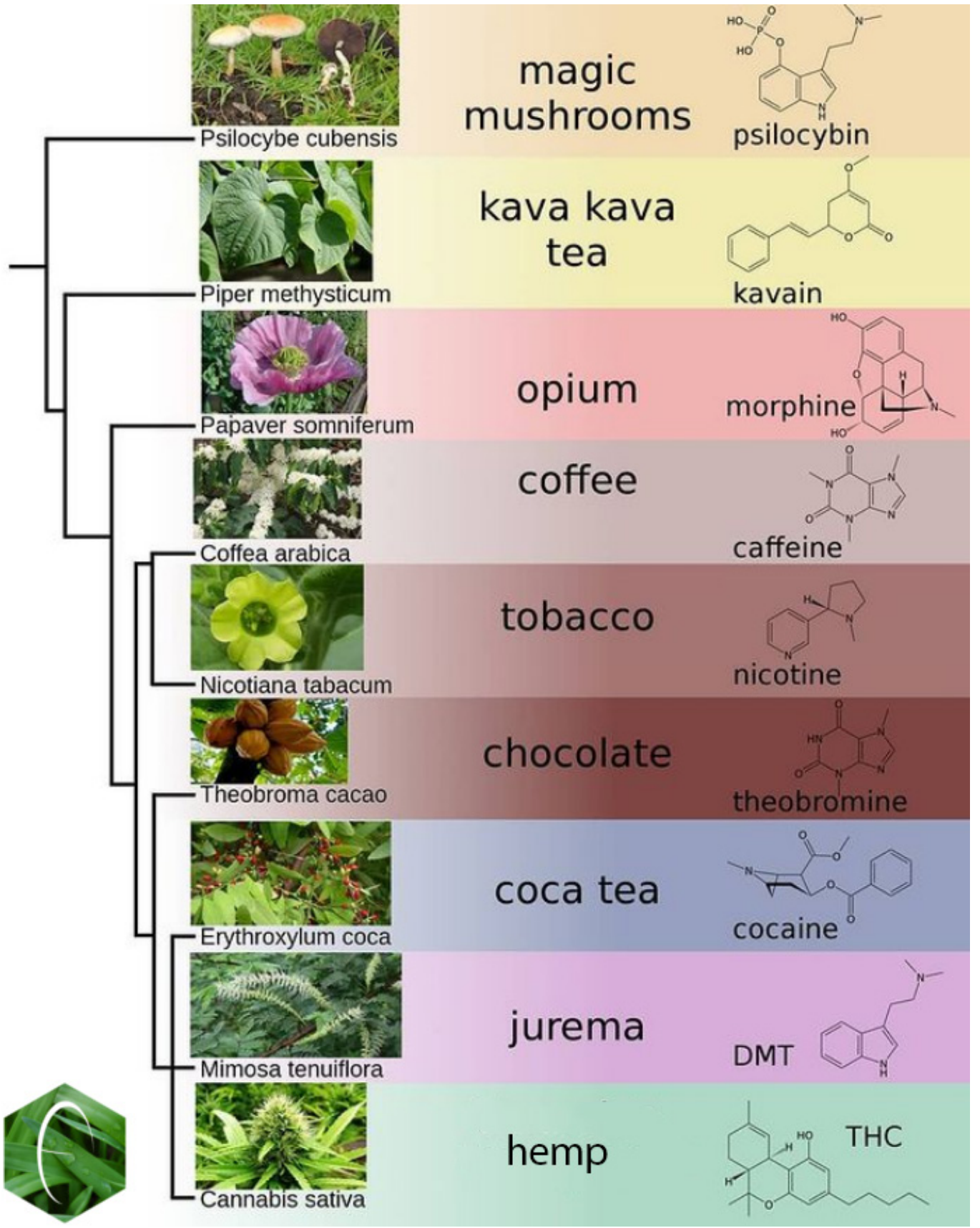

## THIS PAGE: ENDOGENOUS NEUROTRANSMITTERS

*Glutamate is the most commonly used excitatory neurotransmitter; GABA, the most used inhibitory one. Significant with respect to wakefulness and attention (think ascending reticular activating system—ARAS) are serotonin, norepinephrine, acetylcholine, histamine, and orexin. Adenosine and melatonin affect sleep/wake cycles. Dopamine seems to play a role in the fluidity/speed of movement/thought. Not shown: Endogenous cannabinoids anandamide (arachidonoylethanolamide) and 2AG (arachidonoylglycerol).*



## FACING PAGE: EXOGENOUS MOLECULES (FALSE NEUROTRANSMITTERS)

*Endogenous means 'within created,' i.e., within the body; exogenous is 'outside created,' i.e., molucules you find and put in your body which make their way through the blood stream, cross through the 'blood-brain barrier' walls of blood vessels in the brain, and affect neurotransmission by competing with real neurotransmitters in binding to available receptors, with varying efficacies (agonize/excite, antagonize/calm) and with varying tenacity (high affinity/stay attached, low affinity/detach quickly), and with measurable potencies (how much of the molecule is needed to cause max effect).*


Psilocybe cubensis
magic mushrooms
psilocybin
Piper methysticum
kava kava tea
kavain
Papaver somniferum
opium
morphine
Coffea arabica
coffee
caffeine
Nicotiana tabacum
tobacco
nicotine
Theobroma cacao
chocolate
theobromine
Erythroxylum coca
coca tea
cocaine
Mimosa tenuiflora
jurema
DMT
Cannabis sativa
hemp
THC

**“HEYOKAH THE LIGHT BEARER”**

*This beautiful artwork was made by Pavel Souviron to depict an entity observed with nn-DMT. Note some exogenous ligands may be harmful and/or regionally penalized.*


# 6

# *Ring Discovery*

*Be alone, that is the secret of invention; be alone, that is when ideas are born.*

*— Nikola Tesla*

On January 1st of 2022, in room 112 of a hotel in Chattanooga, TN, I took a couple hemp gummies (one indica, one sativa) that resulted probably in a deeply hyperpolarized state, and saw beyond the veil of consciousness! As far as I knew then, it was the first time anyone has 'seen' their own awareness being drawn/refreshed by rings.

However, as I noted earlier, Carl Sagan beat me to it—he called them 'outlines of...instant appreciation.' Steven Lehar also describes an audio-visual refresh of a carpet rug that sounds exactly like the rings. But, it was my first time, and I think my observations on rings and bank are still unique.

I've always said that I don't know how perception is generated, but at that point, I knew—not the neural mechanism—but the mechanism directly underlying experience. Slowed down mentally to a point where I was experiencing existence in jerky start-and-stop cycles rather than as a continuous stream—about three to ten per second to be exact—I was in philosopher's heaven. The issue I had been trying to understand for years finally broke open, and frankly, it blew me away. I realized more in that one night about qualia and experience than I had for the previous year—hell—it was more than I'd learned my entire life!

These cycles were like etheric or referential rings, that could be described as being drawn by an invisible, but potent, tracer. How do you describe such an etheric ring that is experienced, not seen?[22] Icy-cold rings or fiery-hot ones both kind of conveyed the idea, but my first notion was to call them 'rings of fire.' The next day at the aquarium, I even saw a display on the 'Ring of Fire' set of volcanoes around the Pacific, and thought it really was a fitting name.

[22] The 3D location of the tracer/ring is known prior to a viewer, and the substance is invisible, kind of like the path of the silent eye of a hurricane with turbulence right around it.

I think the cyclification of experience into lags + bursts (rings) at 2 Hz or slower enabled entire focus upon a single qualia at a time. If the tracing of one ring occupies 0.4 seconds, and 4 qualia are given time-division slots, then you could get 0.1 second complete attention to each qualia in sequence (and in phasic division on the ring [first quarter, second quarter, etc.]). And I think this was part of what blew me away. In subsequent experiments, I've noticed the biting down onto a veggie sandwich's 'crunch of lettuce' occupying the entirety of consciousness for roughly half a second. It is moments like these that make you realize all the qualia are getting drawn with this same ring tracer. It's all just exquisitely complex modulation (frequency, amplitude, location) of this tracer combined with subconscious linkages that completely conveys the feeling of all felt qualia. Yes, the visual field is a bit of an outlying stinker (possibly), but its refresh appears to be so fast as to be nearly impossible to catch.

I noticed the 'bank' also on this first observation of rings, and called it by that name immediately. I'm not sure why that name, which perhaps sounds idiosyncratic, came to me, but it has stuck and I haven't found anything particularly better yet.

In following experiments, I observed more and more about the rings and the bank. I've noted that the rings needn't always be closed for example (croquet hoops [inverted U shape] are okay too, and even a straight line from 'infinite' left to right in front of you may be used to refresh your consciousness). How can a freaking straight line refresh your 3D consciousness? Well, it seems to serve as a 'sufficient to trigger' mechanism, combined with 'flow' in the fusing schema. In other words, this straight line represents the union of enough information from multiple 3D schemas (external, internal, bank) to make all three pop into one combined experience.

I thought I knew a decent amount about the brain when this experience happened, but I realize now, as I am rewriting this book, that there was a lot I needed to grapple with. The brain is just one of those things that I guess takes more work than you'd think to really get up to speed with. Now that I've studied brains and consciousness for a couple years now in the context of my theory, I think I am able to present it in clearer, more reasonable terms (let's see how I feel about this in another two years, huh?).

But this part of my thinking was true: *What if—instead of starting with matter and examining brains—we could start with consciousness and go towards matter?* What if we could *break it down* so that we could see what constituents directly underlie the conscious experience? That would represent some low-hanging fruit! It turns out there *are* ways to alter consciousness and even to temporarily break it. Neurotransmitters are the

language of neurons, and there are lots to choose from. I've found ones like coffee (caffeine), melatonin (sleep), and serotonin interesting, as well as lesser known ones like St. John's wort (smoked or drunk as tea), pu-er (tea), sun opener (tincture or drunk as tea—I don't recommend this one as it can leave you feeling bruised all over the next day!), and blue lotus (smoked or drunk as tea, but far more effectively taken by means of a quality vape pen). I have read and discussed with others the effects of other things like meth, coca, or opioids, just to understand their effect. But standing far above any of these in terms of usefulness to the consciousness question has been hemp!

But, it's probably doing the same thing as alcohol, Ketamine, or even plain old sleep deprivation—although it seems to do it more effectively. So while there is some stigma around hemp, any of the above could have been used to achieve NMDA-antagonism and hyperpolarization. I have noted rings in normal-state consciousness when relaxed with eyes closed; and, in a similar situation after two glasses of wine. But, I probably wouldn't have noticed the rings without hemp or severe sleep deprivation clearly revealing them first.

Hemp, legalized in 2018, can be a very useful tool. Most if not all other neurotransmitters act on prograde neuron receptors (those on the dendrites of the neuron next in line to fire); hemp's THC acts on retrograde receptors (at the end of the axon of

**CANNABIS LEAF — CROSS SECTION**

*140x magnification.*

**CANNABIS UNDER THE MICROSCOPE**

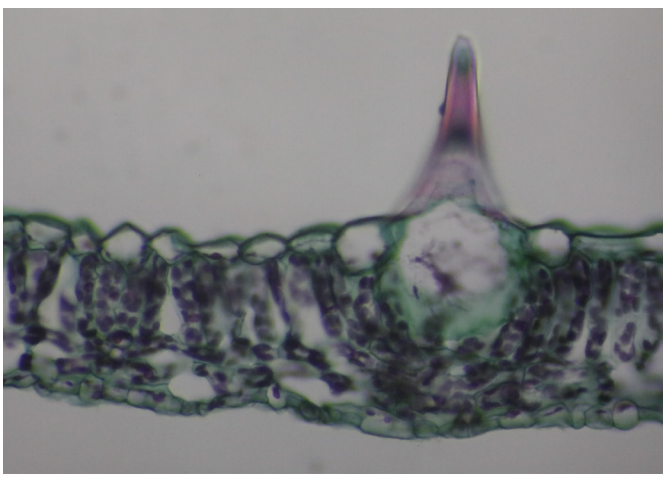
*Image behind this caption: Cannabis flower, 2.5x magnification.*

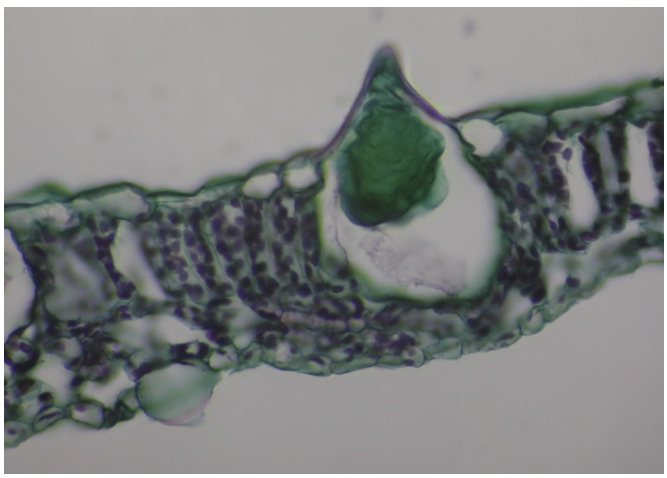
*This page, top photo: The green (and purple) pointy bulbous packs are trichomes (tiny plant outgrowths), filled with cannabinoids and terpenes. The plant actually uses them as a defense mechanism especially when flowering to protect against intruding pests. The pointed structures and strong smell are thought to deter insects and animals. 245x magnification.*

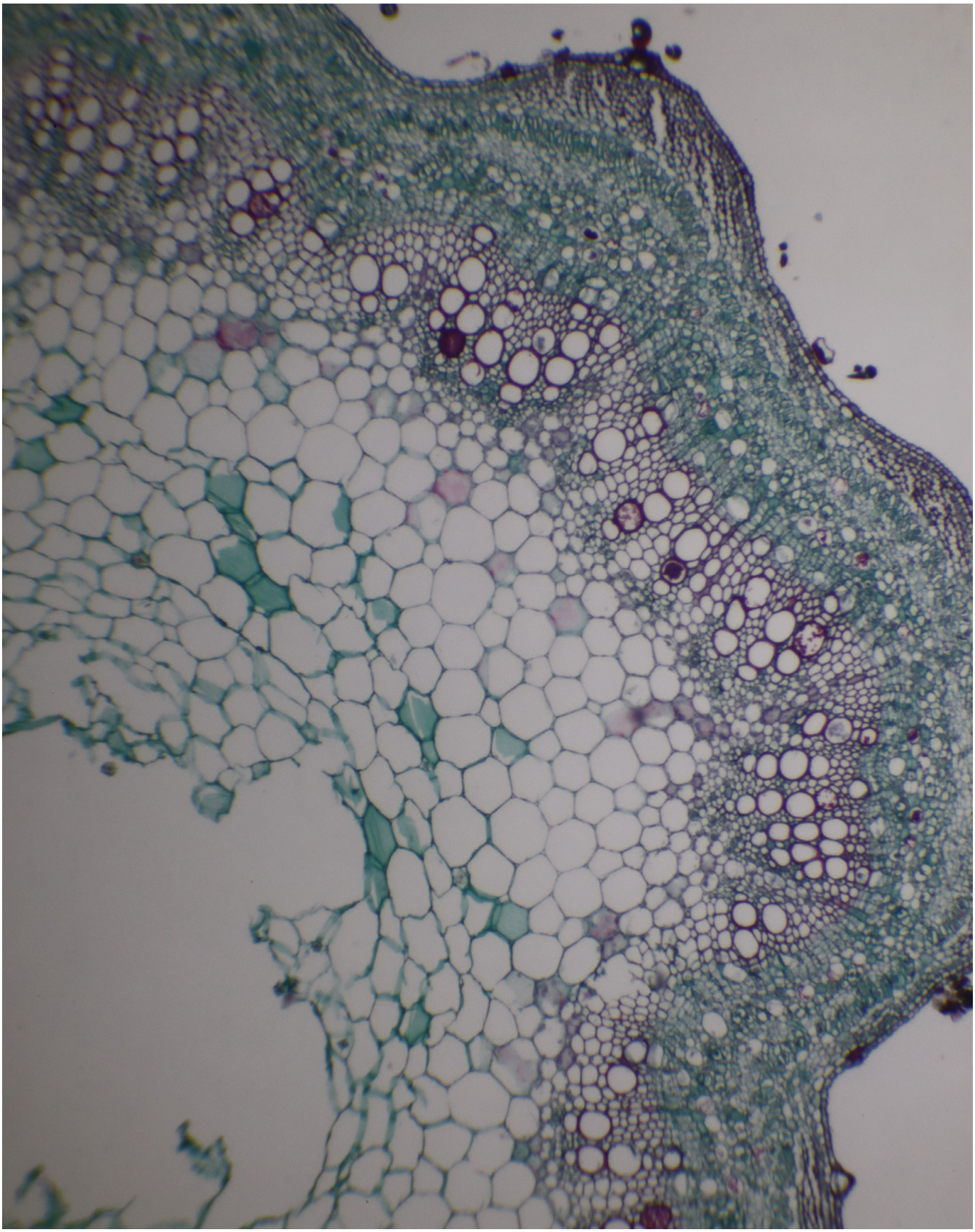
*This page, lower left, lower right: 735x magnification.*

*Facing: Cross section of a cannabis stem, 125x magnification.*

the preceding neuron). Hence, it has the effect of pinching the end of the hose somewhat. My feeling is that cannabis acts in at least two ways — it can depress the firing of neurons in parts of the brain





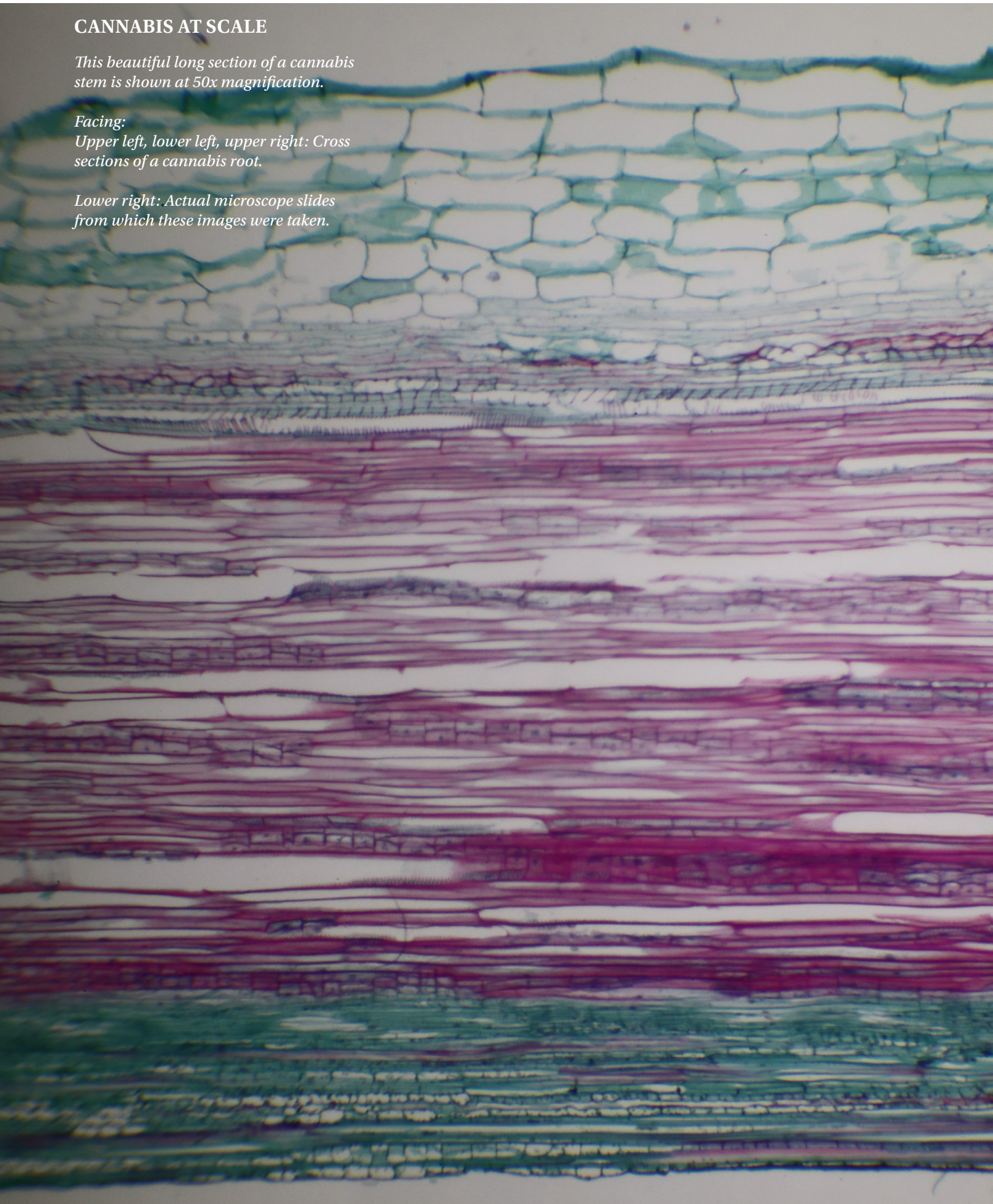


## CANNABIS AT SCALE

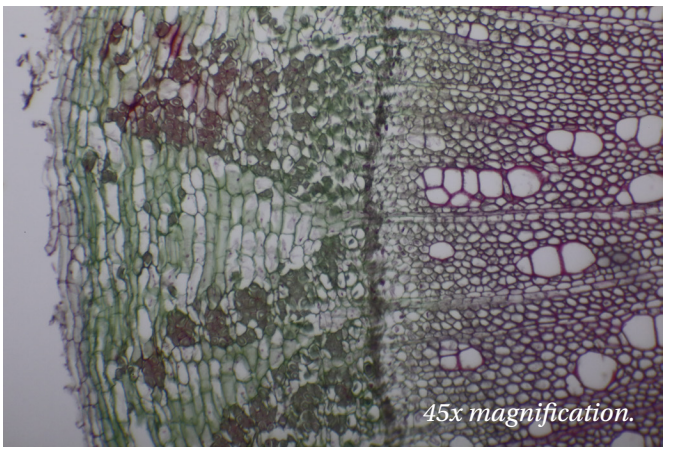
*This beautiful long section of a cannabis stem is shown at 50x magnification.*

*Facing:*
*Upper left, lower left, upper right: Cross sections of a cannabis root.*

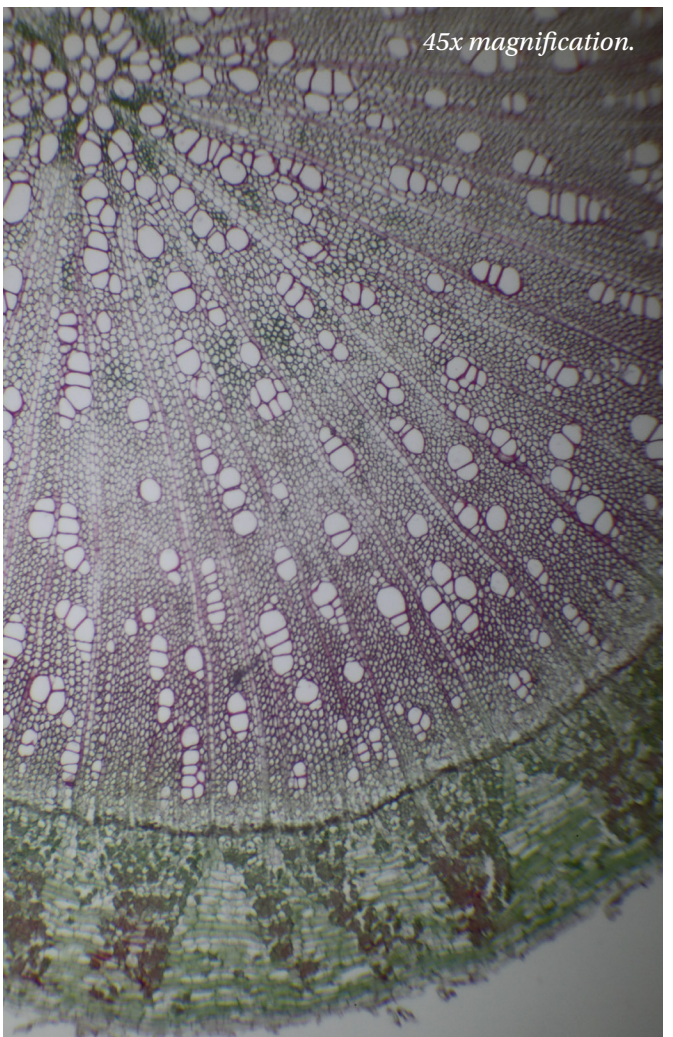
*Lower right: Actual microscope slides from which these images were taken.*

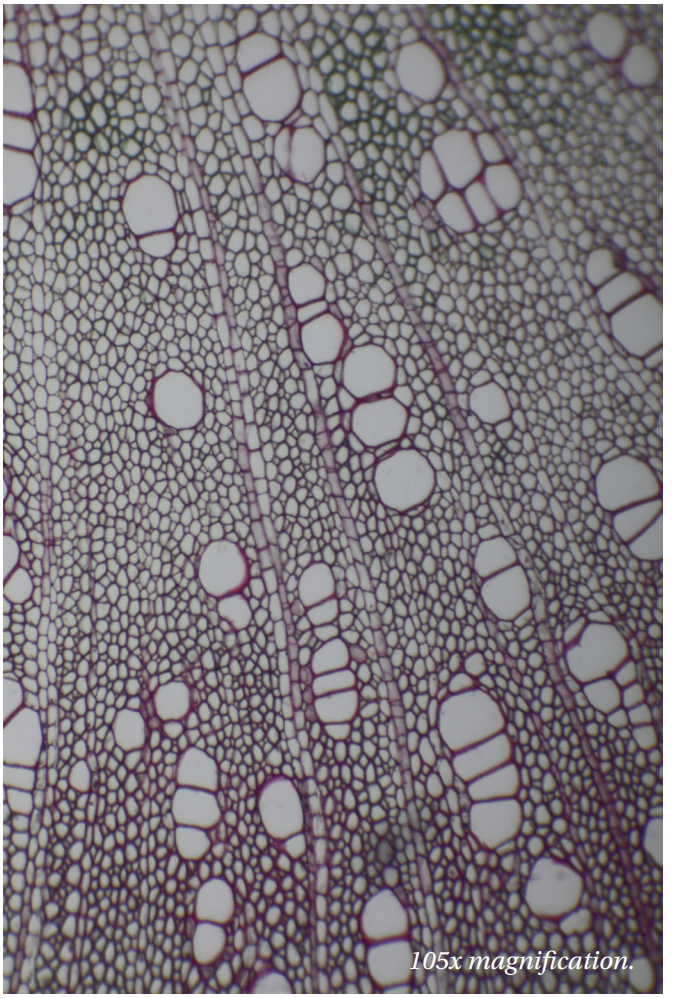


(PFC, hippocampus, cerebellum, basal ganglia) making one feel relaxed, but it can also induce a pleasant dissociative effect—my reasoning for


45x magnification.

the latter is that in layer 5 of the posteromedial cortex (retrosplenial cortex, precuneate cortex, posterior cingulate cortex) there are neurons with


45x magnification.


105x magnification.

HCN1 “pacemaker” ion channels. The THC blocks release of glutamate so that fewer NMDA receptors

**ST. JOHN'S WORT**

*'Wort' with an 'o' means 'plant.' This image was taken near the beginning of Apgar Lookout Trail in Glacier National Park, Montana.*

*A sort of herbal medicine, this plant has a multifaceted effect on the brain, probably mostly as a selective serotonin reuptake inhibitor.*

*Effects could be described as giving one more 'resevoir.' Some consider it too stimulating to the cardiovascular system, whether actually or just perceptually.*

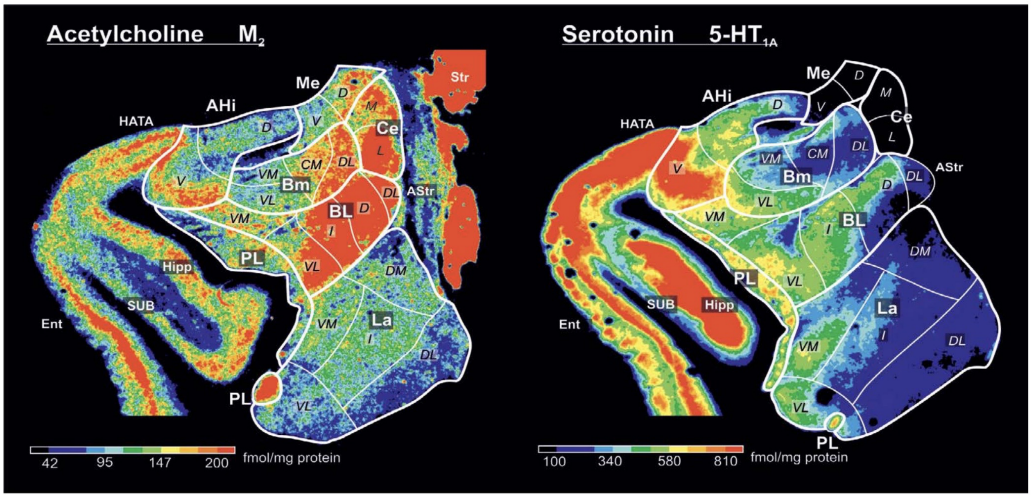



**Figure 1:** Distribution of Cholinergic $M_2$ and Serotoninergic 5-$HT_{1A}$ Receptors in the Human Amygdala.

Subdivisions of the amygdala were identified in the color-coded receptor autoradiographs immediately adjacent to Nissl-stained sections in the right hemisphere at the level of the central nucleus. Color scales visualize the concentrations for each receptor (cholinergic muscarinic $M_2$ or serotoninergic 5-$HT_{1A}$ receptors). After incubation of 20-µm thick coronal sections with the respective tritium-labelled ligand and exposition of the sections against the tritium-sensitive films, the films were developed, digitized and transformed into the binding site concentrations (fmol/mg protein) by using a nonlinear calibration curve between co-exposed plastic [$^3$H]-standards of a known, step-wise increasing radioactivity and the gray values of the actual autoradiograph [1].

Amygdaloid subdivisions (mapping is based on the parcellation scheme of the previous study [2]: AHi - amygdalohippocampal transition area (from the superficial amygdaloid group), Bm - basomedial nucleus, BL - basolateral nucleus, La - lateral nucleus, PL - paralaminar nucleus (constitute the laterobasal group), Me - medial nucleus, Ce - central nucleus (constituents of the centromedial group, classification from [2]).

Parts of the subdivisions: CM - caudomedial, D - dorsal, DL - dorsolateral, DM - dorsomedial, L - lateral, M - medial, I - intermediate, V - ventral, VL - ventrolateral, VM - ventromedial. Adjacent structures: AStr - amygdalostriatal transition area, Str - striatum, HATA - hippocampal-amygdaloid transition area, Hipp - hippocampus, SUB - subicular complex, Ent - entorhinal cortex.

## BLUE LOTUS

*Called the party drug of anceint Egypt, this flower has an almost ineffable effect on consciousness, but it could be described as relaxing, philosophical, and mentally stabilizing (anti-psychotic). It's also a known (mental) aphrodesiac.*

*Blue Lotus has at least two major molecular components — nuciferine, which antagonizes (calms) serotonin 5HT-2A (the same receptor that LSD agonizes [excites]); and apomorphine, which mildly excites 5HT-1A (also calms 5HT-2A).*

*5HT-1A is the receptor that 5meo-DMT potently agonizes— described as giving a sense of benevolence (love), and oneness with God. I think I've read that there are high concentrations of 5HT-1A in the temporal poles (Brodmann's area 38, where high-level social processing and representation of personalities abstracted from their bodies may occur), but cannot verify this.*

*5HT-1A receptors are found in raphe nucleus dendrites, entorhinal cortex, frontal cortex, hippocampus, insula, and amygdala. In the image above, you can see the density layout of 1A receptors (and muscarinic acetylcholine M2 receptors) in the aygdala. It also shows subregions of the amygdala.*

are activated (on prograde dendrite receptors), the cell gets hyperpolarized, and HCN1 channels open and initiate a 2-4 Hz dissociative pulse. This 2-4 Hz oscillation might telegraph through (via the anterior ventral and latero dorsal nuclei of the thalami) to the parietal cortex, and may, over and above the cyclization, occasionally set it out of phase with the prefrontal cortex (activated via the anterior medial nuclei of the thalami), resulting not just in gaps + frames, but also in dissociation. Ketamine (an NMDA antagonist) is known to occasionally generate this result.

So the idea is that in causing PFC and PMC/PPC to get out of sync, dissociation occurs. You may have experienced this—if you've ever been sleep deprived and felt yourself float away from your body and noticed that your body was quite able to keep doing whatever it was doing, even without 'you' there present to help it, then that is exactly what I'm speaking of! There is *temporal, spatial*, and *spectral* dissociation—temporal dissociation is time slowing down (five minutes feels like fifteen); spatial dissociation is the sense you are outside of your body looking on; spectral dissociation is having an internal tempo in line with the frames of your consciousness rather than with the tempo of the song that your avatar is listening to.

The following is an excerpt from my initial notes on observing rings, January 1st of 2022.

**I got up to use the bathroom. On the way back, I noticed I was experiencing life in rings. Everything felt 'slowed down' (or the visual world was dampened down) enough that I could see each little item I was focusing on. First on a ring was 'your left elbow will open,' although not in English—just the awareness of an impending inertial change going to be brought about by engaging my triceps. Second on the ring was circling upwards and to the back of my body say about the back of my neck—this part of the ring was simply going to signify my mood and outlook at that moment. Third on the ring was circling up and over to the right ear where the feeling of part of the noise of the furnace running was encoded. Fourth on the ring was a colored section of it, representing the color of something...Now** *all of that* **happened in probably about a decisecond or two...Once the ring was drawn and set there for [50 ms], then I was jerked forwards to a new ring being drawn. In fact, I could somewhat see this now-current**

**ring at the point of time of that previous ring I just elaborated upon, but now it became the present. And so there was a series of unstoppable and unslowable rings, pauses, launches forward, etc., etc. Leaving out the pause, for every cycle of consciousness, there were two basic components, a *frame* and a *transition*. (1) The *frame* [set] up spatial, positional, and inertial bits of info about a slice of the body (and world if eyes open) as well as the flat/informational components of whatever qualia are being focused on in that moment. It's like (a) a 'film exposure,' (b) a squiggly 'ring of fire,' drawn out from start-to-finish with a fiery cursor, tracing out a thickened slice of one's body (and world[23]) and encoding for pertinent info at spots along the ring's circumference, or (c) an 'electron beam' of an old TV as it lights up luminescent phosphors on the screen, being bent by magnetic and electric fields to hit each pixel from left to right in a row, and then downward completing each row from top to bottom and hence lighting up the whole screen...[24] (2) The *transition* moves you along to the next frame and gives rise to the glossy, smooth, slick, full-bodied aspects of qualia and consciousness. It feels like (a) a 'gear turn' (the ring has gears which turn you inside-out to the next ring), (b) a 'film advance' (to the next frame as if someone were engaging and advancing the film of 'you' in an old film-camera), or (c) a 'water slide' (someone pushes you down and you are at the ride's mercy until the bottom). Let's talk more about the *frames*. They felt most like 'rings of fire'...it could rotate...to a different orientation at each new frame, and did so in order to create 3D perception**

23 Eyes closed or eyes open. As mentioned already, exactly how the visual field within representation space is 'printed' is a bit mysterious, and might involved 'helper' encoding mechanism, such as rate-coding, or some Fourier transform. The intense focus of the brain's printing activity seems to be focused on the rings and their 'cutting' of the visual field. The portions not on the ring get triggered.

24 The rings' 'electron beam' has a slower refresh rate of about 10-40+ Hz, and traces out a squiggly ring through 3D rather than rows and columns. Could the 'electron gun' doing the tracing be the thalamus, guided by the prefrontal cortex and hippocampal memory? Or does the ring trace itself via the meshes of horizontal connections in layers of the neocortex, neurospatially or encodingly?

**out of 2D 'rings'...they also felt like I would be better to interpret them as I always had—not as neural firings—but as changes in movement of my limbs, and just as a general tracing out of a 2D ring around part of my body and of the outside world (again, fleshed out above and below the ring a little via the further firing of smaller branched neurons[25]). It also felt like locations on the ring could vibrate with varying frequencies to encode various kinds of information such as what color, what quality of sound, what location as in distance outward from the center, and location as in how far up or down from the ring (providing the aspect of thickness by telling a little about what is right above and right below the ring). These rings of fire felt like, 'Wait, these are just random neural firings—you don't have to interpret it as an actual body and world—it could be totally random noise. The world could just be your best way of explaining the random noise.' But then I thought about how I can interact with the world, and effect changes by moving objects, and I realized consciousness is modeling a real physical world using these random patterns of neural firings (whether actual firings of action potentials or more likely the post-synaptic potentials in dendrites that lead to an action potential) that we usually can never even interpret as neural firings because we're so convinced (rightly) of the world they are trying to model for us! A baby starts out with nothing, and using the fact that certain patterns appear when they perform certain things (like turn their head to the right)** *in a repeatable way*, **they are able to build ('hallucinate'[26]) a very reliable**

25 I was under the initial impression that my brain was the rings (like the brain was the printhead, and the changes in what it was painting seemed to 'move' the brain around my experience). Such a notion would be an example of 'neuro-spatio-genesis,' which I tend to think is improbable, but if there is some warp of the space of the brain in the linkage to paint, it may be possible that the brain literally is, in its spatial layout, the bank printhead (neurospatial), and that I was experience traveling cortical waves making the rings. I'll try to do some EEG with clear rings soon and see if I notice any traveling cortical waves.

26 As Anil Seth would put it.

**model of the world! They say the brain begins with action first, and then sensory data comes in next to help fine tune the action. If one looks at it from an evolutionary perspective, it would also make sense that simple life forms only needed motility as nutrients in water were plentiful; sensory data could be added as a secondary thing to refine movement when scarcity came. Let's also talk more about the** *transitions***. They felt like 'cogs of qualia' — a sort of 4D (3D plus time) outside-in or inside-out "gear turn" or "revolution" from one ring of fire to the next — this turning of gears gave rise to the normal, glossy, smooth sense of existence and included everything from qualia of color, some aspect of some sound I was hearing, the sense of me as an entity, and every other perceptual thing that I may have attended to. This gear shift jerked me forward from the current ring of fire to the next, now-current ring of fire (the arrow of percepted time). The** *present-tense* **thickened disc was always the largest block with a single, smaller** *past* **disc fading away, and a single, smaller** *future* **disc ahead in formation. Perception lags reality by about 150 milliseconds, and I suppose this is how the brain is able to generate an idea of the future ring before it gets there. Nevertheless, the** *clearest drawing* **of the ring only happens when it is in the 'current ring' position. The past ring feels like an 'afterburn' and the future ring feels uncertain. How the brain does this I don't know…Anyway, the future ring is there, but doesn't get written in stone until it's in the 'current ring' position…[later that night] the rings of fire were drawing 2D puzzle pieces (discs** *with thickness***) of my spatial existence; which, when I went from one disc to another and the disc was changing orientation (say from a horizontal plane, to a more vertical plane, to a more sagittal plane), I 'hallucinated' (by assuming I** *had* **all the gaps and missing details[27]) the beautiful 3D…world that is so accurate, we usually…**

27 Maybe I did, but just subconsciously. 3D seems real, but perhaps encoded separately.

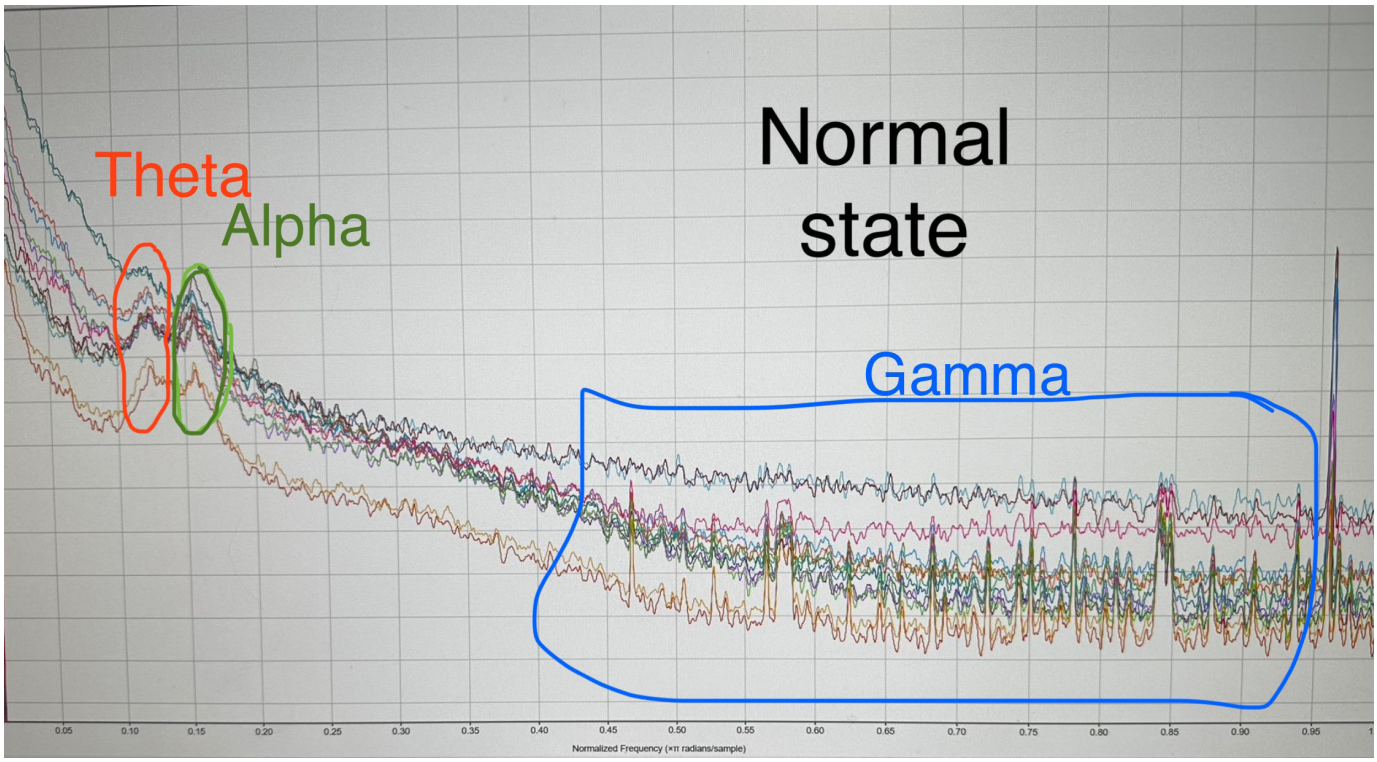
**mistake it as *being* the physical world! So this whole experience was very riveting, but what exactly was going on?...Action potentials are an all-or-nothing event...I must admit that... aspects like color still seemed ineffable in the sense that they seemed too fast a vibration to elucidate even though I could see them 'right there' on the ring and feel them in the [transition]!...was the ring shape drawn not physically in a ring around the cortex or hippocampus, but rather, whatever neurons were involved could be anywhere in the cortex...and they simply used *phasic firing* to create the simulation of a ring?... for that matter, a ring doesn't even need phasic firing—since the whole of perception is 'hallucinated' from repeatable, meaningful patterns, just let a certain pattern always mean a location on the ring [/bank]—and map specific neural patterns to it—and voila!—you can have your ring [by 'pattern-spatio-genesis']!...I was able to see [thousands] of the [theta/alpha attentional] 'rings of fire'...before they smoothed out and normalcy returned; in the process they morphed from seeming like rings...to seeming more like 3D puzzle pieces [thick discs] being laid down one piece on top of another at a very fast rate... 3 to 10...per second. The moving of your *mental attention*, decisecond by decisecond, appears to be the main component of consciousness. What's interesting is how akin it is to how your eyes work via saccadic movements. It would make sense that the brain would share some functionality with other observed parts of our bodies. Our eyes are often changing where they are looking, sometimes multiple times a second, so that the fovea (the highest resolution part of the retina of your eye) can attend to various things that warrant further scrutiny. The rate of saccades isn't set in stone, nor is the speed, nor the angular distance covered. I think this is a good picture of the brain waves behind perceptual attention (frame rate varies from moment to moment [3-10 Hz in my case]), except that it seems impossible**

**to move great distances in logical thought without taking all the necessary intermediate steps. It's almost as though the brain is moving by choosing how to *interpret* things, and it can interpret them more and more in a certain way, but can't do so in a single go. So how are decisions made? Where does will reside? In my experience, it felt like will was a real thing, but 'hallucinated' or 'actuated' upon the gear turn between two rings...It was like there was no choice brain-wise (only input and output based on learned responses), but the will arose atop the change and, though ethereal, or because ethereal [subconsciously enacted?], was more real than the...world itself.**

So, after months upon months of study, I think there are a few things going on here, which have decent data backing them up. One is 'staccato-ification,' if you will—the taking of these normal brain cycles (helix cycles through perceptual spacetime; rings when considering just static space snapshots) and introducing hyperpolarization which, at 2 Hz, leads to ~250 ms lag, followed by 250 ms of sped-up sampling (ring trace), but the match to incoming content remains accurate to the new, delayed and narrower window. The second phenomenon is the 2 Hz itself. It is not, in normal-state consciousness, a frequency at which you get a power peak, at least not in the wakeful state. The third observation is that the brain seems to be incredibly good at changing, in real time, its speed of tracing rings (even by an order of magnitude!). In other words, rings can change from 2 Hz to 20 Hz near-instantly to pay extra attention to something in the visual field (in the hyperpolarized state).

So, faster frequency rings (faster frequency brain waves?) seem requisite for fine detail, and may be necessary to enable the 'cutting' of color-triggering detail. When I first heard that color might be related to shape, I thought it was incredulous; but, if one considers color as reserved as a detail requiring fine modulation of the tracer's 3D position while traveling along the 1D ring path, it might actually make sense. Again, colors (and white) are apparently the fastest frequency component of consciousness, the most fleeting (iconic memory lasts only 50–500 ms after closing your eyes), and the least-stored to long term memory.

But to get back to the three observations, let's look at some data. One normal-state EEG session (thirty minutes long) showed peaks around theta (6.8–8 Hz), alpha (9.9 Hz), and a myriad of gamma (29.3, 31.6, 32.9, 35.3, 35.9, 36.1, 42.7, 45.1, 46.9, 48.8, 50.6, 52.5, 52.7, 52.9, 54.8, 56.7, 58.5, 62.2 Hz).

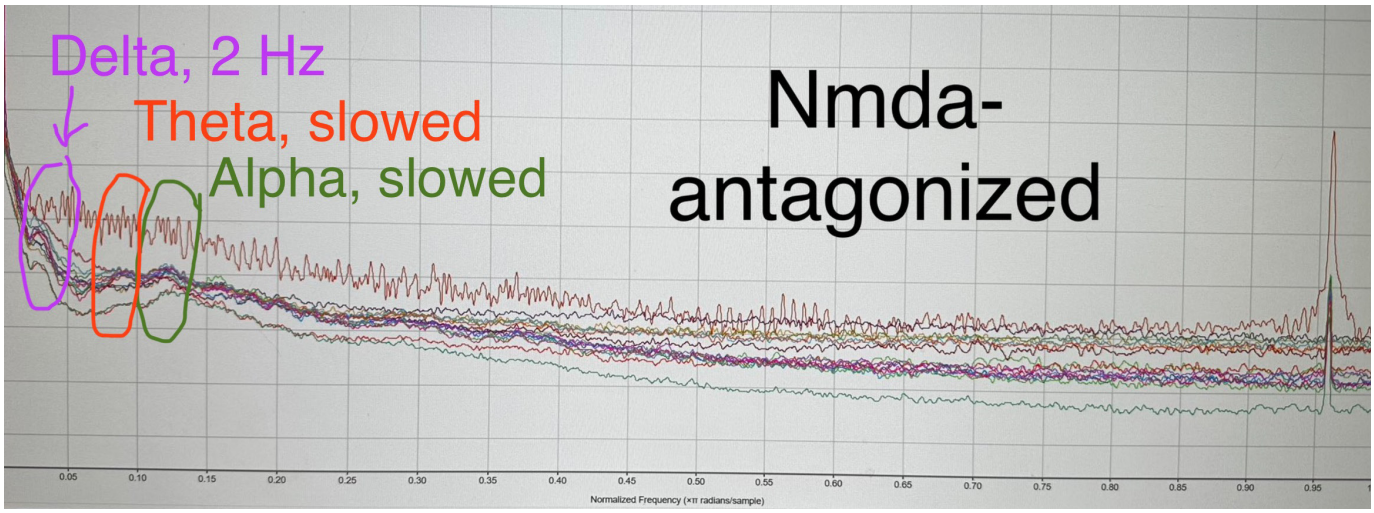



But a similar hyperpolarized EEG session (again, thirty minutes) showed a down-shift of theta (5 Hz) and alpha (8 Hz), the abolition of all the gamma peaks (though a slight rise in the power of gamma), and, most interestingly, the creation of a new band at 2 Hz. NMDA-antagonism was the method of achieving hyperpolarization in this case.

Deisseroth et. al.[28] also published a paper showing that Ketamine (in rats) induces a roughly 2 Hz staccato-ification of the 'train' of action potentials coming from layer five of the retrosplenial cortex (HCN1 channels). Occasional phasic anti-correlation ('180º out of syncness') between regions was also noted (correlate of rarer dissociation above the baseline staccato effect of hyperpolarization?).

A depiction trying to convey the findings of that paper is shown on the facing page (lower image). I apologize that I was using the term 'cyclization,' as that is confusing. In my theory, even the smooth trains of action potentials contain functional cycling through perceptual space over time at some frequency. So the effect where you get gap, frame, gap, frame would better be termed a sort of 'staccato' effect imposed on the cycles to bunch each frame up into a shorter, sub-cycle duration. Each hidden functional cycle gets bunched up or compressed. Then, these bunchings and gaps unveil (to the first person experiencer) the mechanism that is so inscrutable to normal-state experience. At last, it appears phenomenology and scientific observation are shaking hands!

28 Vesuna, Sam, et al. "Deep Posteromedial Cortical Rhythm in Dissociation." Nature, U.S. National Library of Medicine, Oct. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7553818/.



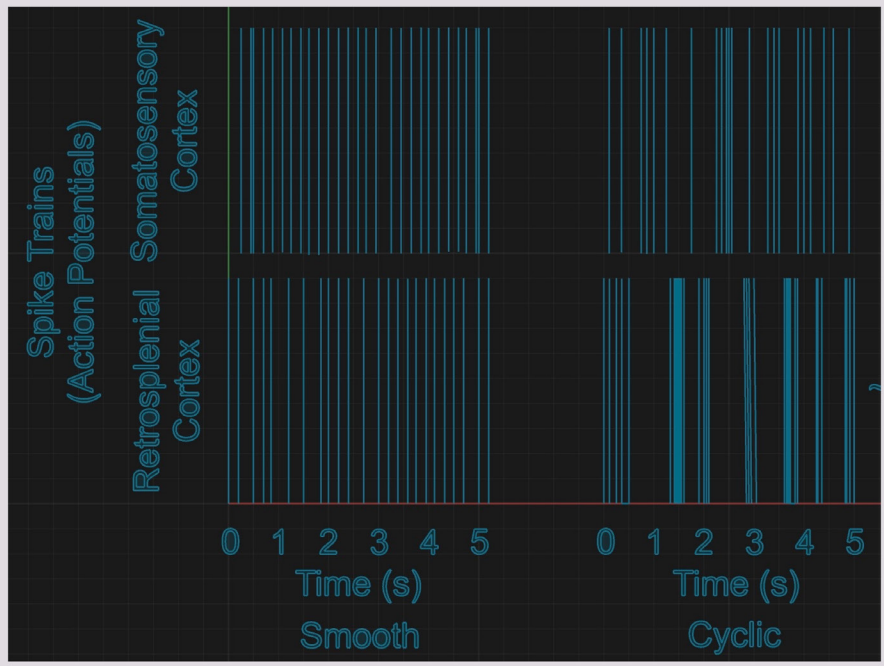

In 'The Thalamus,'[29] the discovery of 'T-Channels' by Rodolfo Llinás et. al.—present in all relay cells of the thalamus—is discussed. Upon hyperpolarization, these cells switch from smooth dynamic firing (10–70 Hz) to staccato-style gap+burst mode, where they are silent for 250 ms, then burst (at 80 Hz) for 250 ms, then silent for 250 ms, then burst for 250 ms. In other words, the hyperpolarization activates the T-Channels, resulting in 2 Hz 'dicing' of the incoming stimuli. So, first-hand observation notes 2 Hz 'frames' or 'rings,' and scientific experimentation finds 2 Hz 'staccato-ification.'

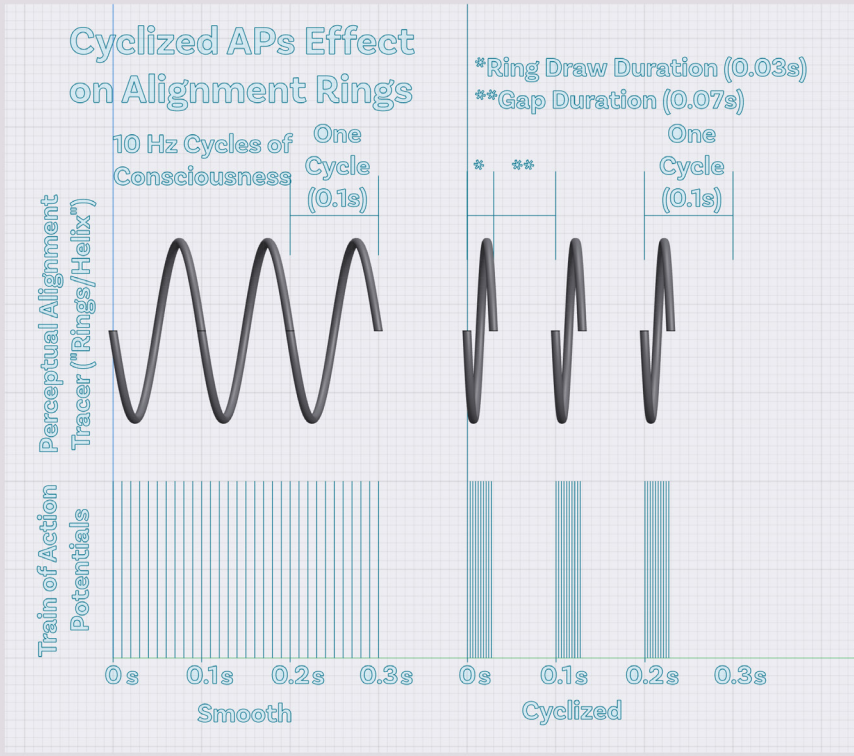
29 Halassa, M. (Ed.). (2022). The Thalamus. https://doi.org/10.1017/9781108674287, page 24.

**Cyclization, Anti-Correlation**

Example of cyclization of spike train of action potentials (and dissociative anti-correlation) after administration of ketamine to rodents.

Vesuna, Sam, et al. "Deep Posteromedial Cortical Rhythm in Dissociation." Nature, U.S. National Library of Medicine, Oct. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7553818/.






## Proposed Effect of Cyclization of Action Potentials On Rings/Helix

NMDA-antagonists like Ketamine and Alcohol may cause the cyclization of neural action potentials, resulting in discrete cycles of consciousness instead of smooth ones. This makes the cycles more noticeable and can lead to dissociation at higher doses. In rodents, cyclization has been observed after Ketamine administration, while pre-stroke auras are characterized by frame-like dissociative properties. This phenomenon is illustrated by the helix-to-ring alteration in the diagram.

Note also that at extreme "bunching," the helix would not only become a set of discrete rings, they would be quite ***planar***, especially for high-frequency cycles like gamma or high gamma.

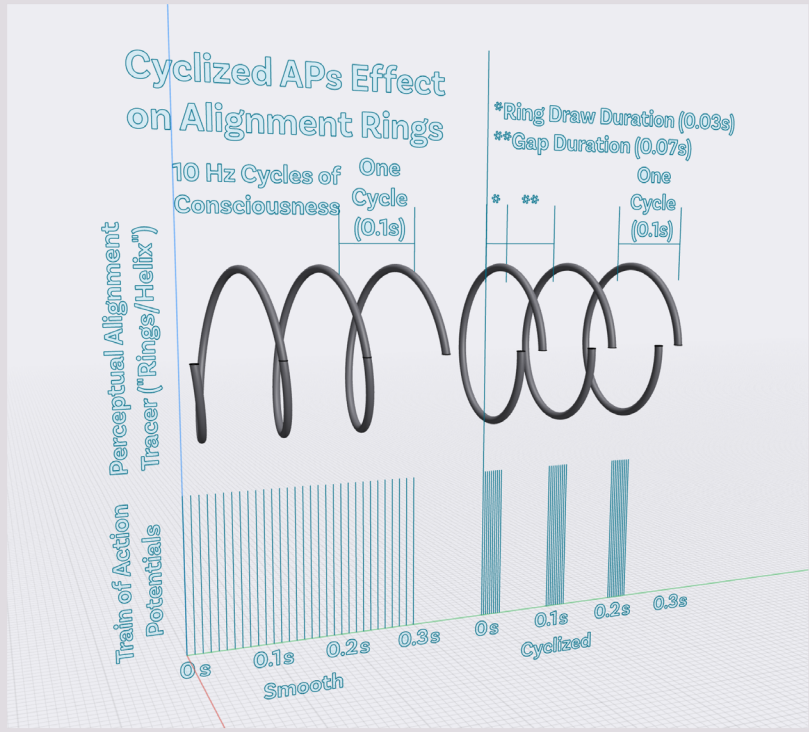
Vesuna, Sam, et al. "Deep Posteromedial Cortical Rhythm in Dissociation." Nature, U.S. National Library of Medicine, Oct. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7553818/.

Rodolfo Llinás also found 2 Hz pulsing from the inferior olive, which goes to the cerebellum. The cerebellum's dentate nuclei project (through the thalamus) back to the cerebrum.

## Helix/Rings in 3D View

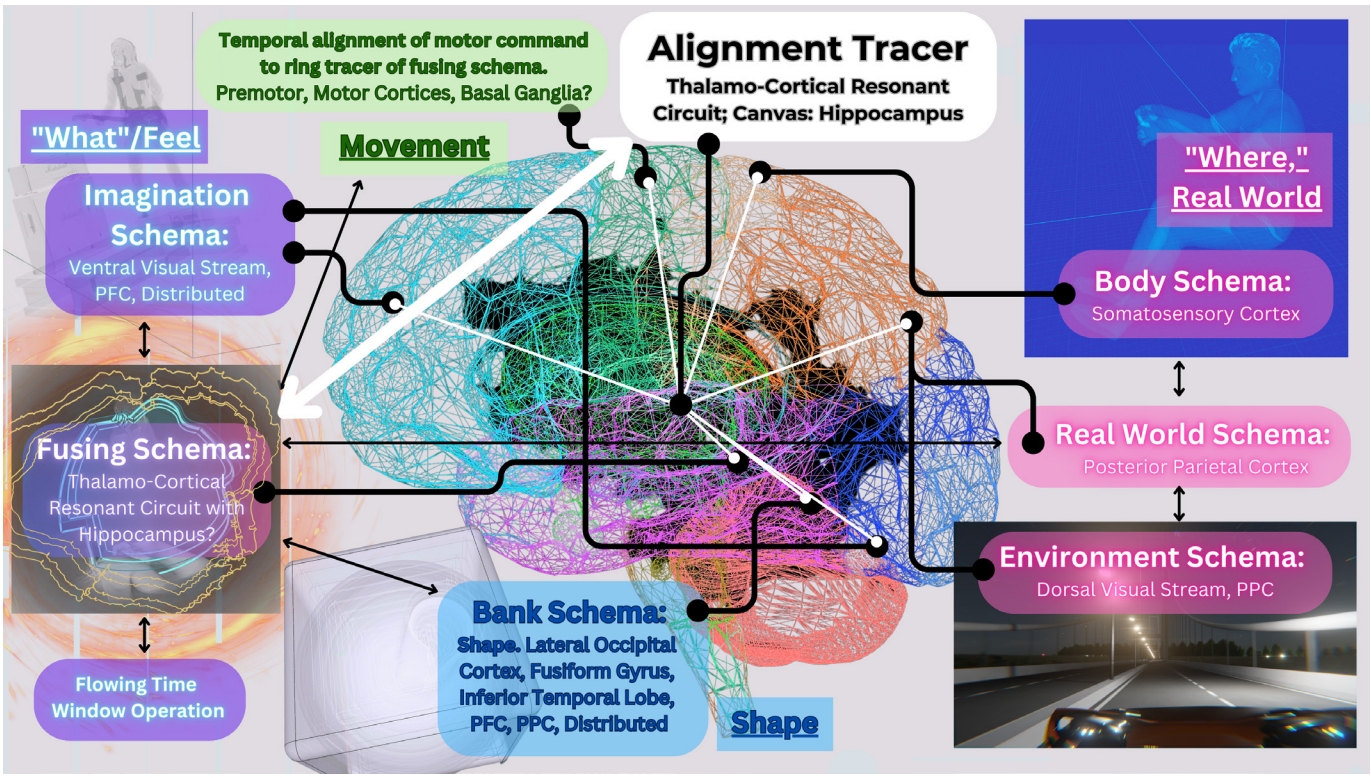
It is important to note that each action potential represents a collection of action potentials, some of which may represent the voxel location within the fusing schema. Quickly cycling through the same sequence of locations along the ring path could reveal a planar ring that guides the tracer, as seen in the cyclized example. However, using the full cycle to trace the ring provides enough offset to make a helix and smooths out the conscious experience, as seen in the smooth example. In this example, it can be assumed that each cycle repeats the same 10 ensembles of neurons dedicated to addressing the location of 10 points along the ring. Over a few seconds, the ring's shape, attitude, and location would change, and different ensembles would be used.

Vesuna, Sam, et al. "Deep Posteromedial Cortical Rhythm in Dissociation." Nature, U.S. National Library of Medicine, Oct. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7553818/.



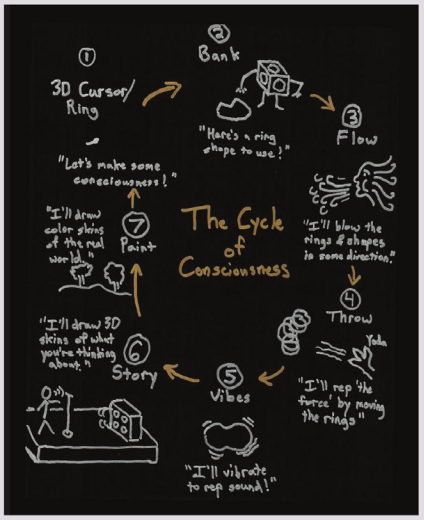
The image below explores possible neural correlates of the subconscious processing and conscious representation of various schemas. Exactly how the tracer following ring paths is implemented I honestly don't know, and while the thalamo-cortical resonant circuit looks promising, other areas such as the prefrontal cortex and hippocampus could be key contributers.

It seems to be the ring scaffolding (context/content marriage) that includes or excludes input/output from consciousness. In other words, there is a group effort of understanding a crafted story, extracting meaning/linkages, and responding, but it uses this special language of the bank. You must 'tickle' bank voxels in specific ways to understand anything consciously and for the prefrontal cortex to then influence or override autonomous behavior. But even autonomous behavior can be knocked out with anesthesia, suggesting multi-tiered siloed components of consciousness, or that group-cooperation is necessary for both conscious and autonomous control of behavior. It could be possible, too, that what we consider autonomous moments are just transient moments of one section of cortex getting out of phase with the prefrontal (or with the thalamo-cortical resonant circuit), and unable to send or receive 'same-paging' signals. When brain regions are out-of-phase at a sufficiently slow frequency, the action potentials during the peak of one region may reach the other region during a trough in Local Field Potential (LFP) such that they do not induce any effect (action potentials) on those post-synaptic targets.



## Meet the Characters of Consciousness

### 2022 Understanding




1. Rings
2. Bank
3. Flow
4. Throw
5. Vibes
6. Story
7. Paint

My understanding was that a 0D point traced a dynamically changing ring path 2 - 1,000 times a second. The ring path could not be blown by the wind of flow, but that which was printed could begin to be moved as soon as it was emitted. The ring path was a selection off a cube/sphere bank of stored shapes. Inertial forces (like turning left in a car) would throw the bank/ring off kilter. Sound would vibrate the currently-being-drawn ring. These rings would somehow encode story (imagination and shape) and paint (visual field, usually real world).

My understanding of concepts has evolved over these couple of years, and these two slides reflect that. My original take was that there were seven 'characters' of consciousness: rings, bank, flow, throw, vibes, story (CMW), paint (SPW).

But I realized that I needed to be a bit more precise. Bank is the uncontested agent of isomorphy (models, Cartesian storage and printing of 2D/3D shape prior to and independent of any viewer/viewpoint). There are perspective viewpoints as a component of consciousness, possible for both external and internal imagery. And the real world schema or external schema is a more conventional term than 'paint' or 'Sensory Physical World.' Likewise, imagination schema or internal schema is a better way to say 'story' or 'Cartoon Motor World.' And, these schemas are best left as 'information realms'—external, veridical information; or internal, contemplative information. The information can be fitted by both explicitly-3D bank modeling (translucent, location-awareness) and by perspective (may be colored), simultaneously, and decoupledly.

At the risk of being overly speculative, I will also introduce one last concept—'skewers.' As you will recall, in the fusing schema, rings are serving as the continual 'clapperboard' (spatially and temporally) for aligning the various schemas (as understood in 3D, even without bank attention). As the tracer follows the ring path, radially outward from the rings, and slightly lagging, are 'skewers' piercing through the 3D fusing schema, but linking

## Meet the Characters of Consciousness

A few dichotomies work better:

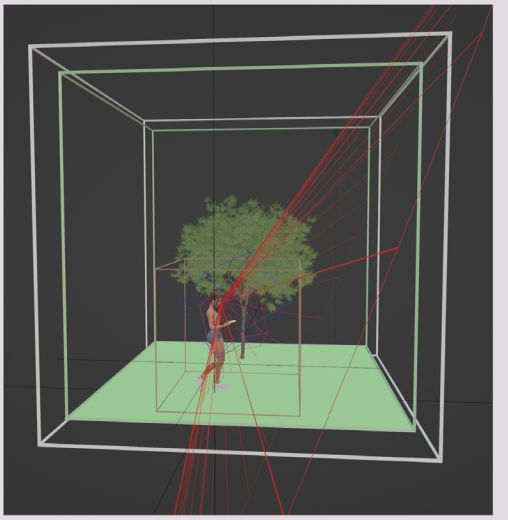
1. Info pertaining to the ***real world***
   (1a. Info pertaining to ***environs***)
   (1b. Info pertaining to ***body***)
2. Info pertaining to ***imagination***

Two means of understanding:

1. Isometric 3D (***bank***-provided)
2. Perspective "2D" (***vector***-provided)

A set of pixel vectors is connected to proper voxels in each cycle of context consciousness, taking a ***ring*** path. Normal to the rings, "future" and "past" are depicted - a one-second "***flowing time window***."

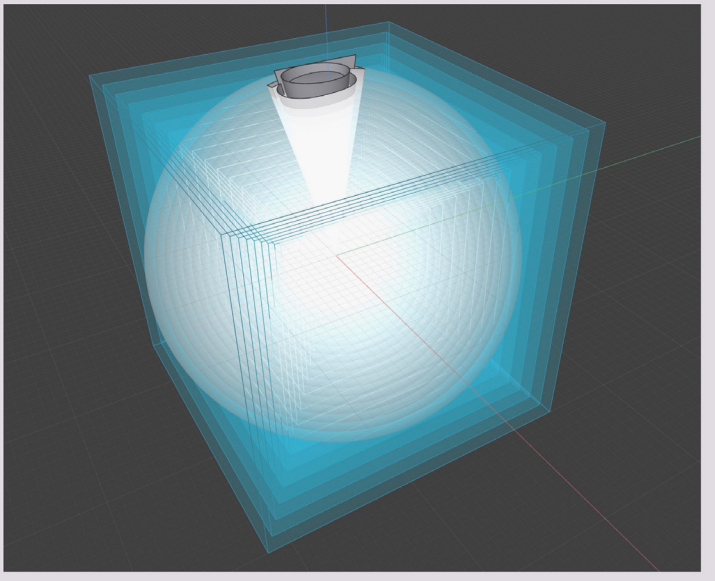
**2023 Understanding**



(at each bit of extra radial depth) to an entire 3D memory (this is actually the use of ***four*** perceptual spatial dimensions, the skewers being the 'hotkey' fourth dimensional link. And when computational

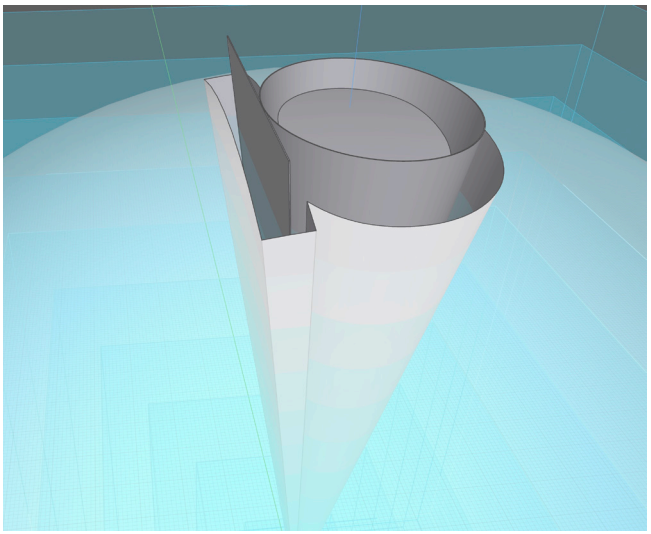
## The Bank Usage for Memory Retrieval: A Layered Approach to Memory Association and Replay

**In this model, memories are postulated to be stored in a layered fashion, from newest to oldest, on the bank structure (a variation of Eagleman's neural pace layer system). When attention is brought to a specific concept, such as the letter 'b,' the hippocampus generates a stack of memories related to that concept, with the oldest being located deeper in the structure. The brain then selects a single layer, or memory, based on its utility, often choosing the freshest one. A brief 0.1 second clip of the selected memory is replayed, containing all relevant aspects of the memory, such as mood, location, and time. This process is instantiated in real-time as needed. One may then ruminate on the memory or move on to the next task. This skewer/layer phenomenon has been observed by multiple persons and on multiple occasions, subliminally, in imagination schema.**



neuroscientists look for patterns embedded in high-dimensional space, they often find meaningful relations in lower, three (and occasionally four) dimensional space.

I haven't yet got my head around the idea that, if one considers single neurons' firing rates as separate dimensions, that the lower-dimensional relations would be useful. But, they keep finding ring structures encoding head direction and many other phenomena, so perhaps 3D perceptual space may be being traversed by 1D ring manifolds via such a mechanism? I don't know, but it's something I intend to look more into.



But, the phenomenon of some shape or concept triggering a host of memories, with the brain near-instantly latching onto one (usually the most recent or relevant) is certainly valid. So why would it matter if the brain utilized representational space is a (usually subconscious) 'trippy' way to help segregate and link relevant memories?

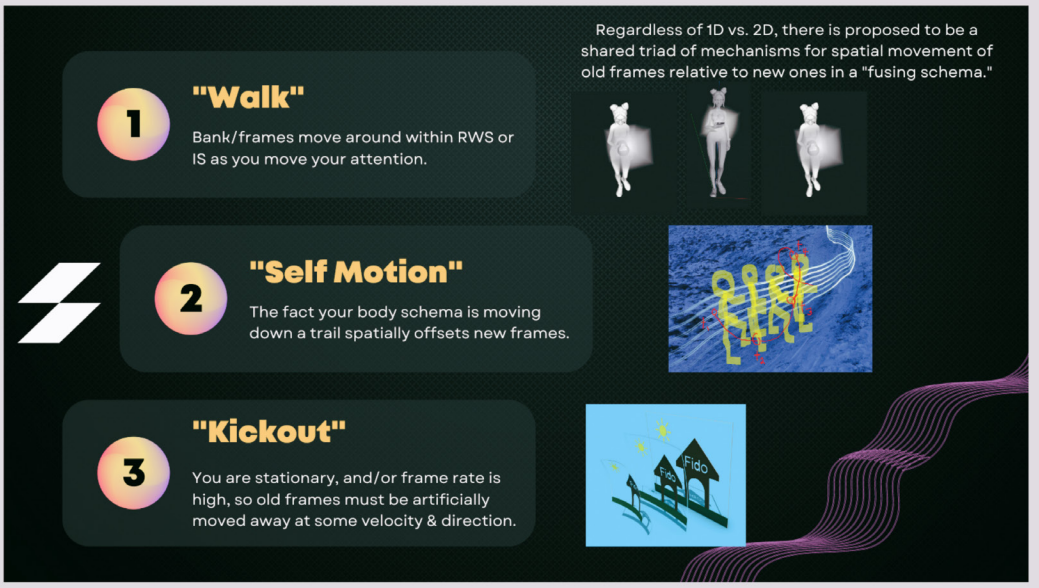
We should also talk a bit more about 'flow.' I was a little overly simplistic when I first introduced you to this concept. Although flow usually uses one axis of the fusing schema (perpendicular to ring plane) to plot one second of futureness to pastness, in fact it is variable. Sometimes it may be more like five seconds. And sometimes it isn't mapped this way at all. For example, if you saccade from one item in your visual field to another, the bank might move in 3D space from modeling the first item to modeling the second item. In the process of moving, 'past' becomes the first item, and 'future' becomes the second item, so that the fusing schema's time flow axis is temporarily this axis in the real world schema going from item 1 to item 2. I call this weird occurrence 'walk' (of the bank across the real world schema or imagination schema). But the first item is fading out, the second item is fading in, and the present moment is the bank position in-between items, leaving 'frames' the whole way. Yet, in normal state, we 'settle in' to only seeing the real world schema as a sequential video (one frame at a time)—yet the subliminal process still goes on under our noses.

But it gets weirder. Another aspect of 'flow' is when you go for a hike for example. Now, your avatar is moving relative to the environment

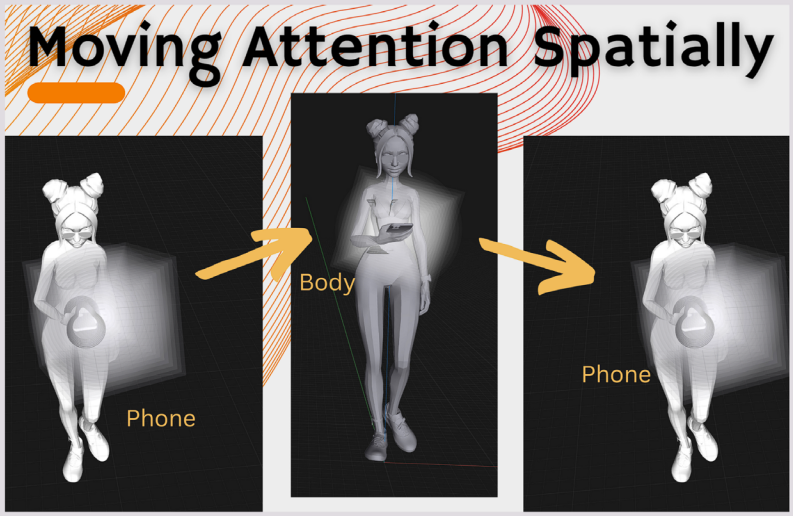
schema (actually, as far as consciousness is concerned, the environment schema is pulled through the avatar schema's space—but yes, in the physical realm, it is the body that is moving, not the world, though Einstein did tell us everything is relative). So when there is relative movement between avatar and environment, 'past' is the avatar frame attached to a place backwards on the trail, and 'future' is the avatar frame attached to a place forwards on the trail. Again, you pay no attention to this in normal-state consciousness, because you get duped into thinking you are literally walking down a trail and that you can magically perceive the surroundings instantaneously. But subliminally, the brain is looking at a time window (usually about one second), which enables Behavioral Timescale Plasticity recording in the hippocampus (one second), as well as sequence prediction, sending motor commands slightly ahead of when they are needed, etc. So here, the fusing schema's axis of future to past is the path of the trail.

And it is when one considers such 'self-motion' that the hippocampus gets really interesting. It adjusts its theta frequency according to the speed with which you walk (or the speed with which you imagine a video game character walking down a hallway, for example). It looks like this region may be aligning the avatar and environment schemas during self-motion, which as I said is a part of the fusing schema's time window. And since I've introduced the idea of skewers as a sort of fourth-dimensional shortcut to link multiple 3D video

Frames of *Context* Resist Pileup: Spatial Offset Mechanisms



## Frames of *Context* Resist Pileup: Spatial Offset Mechanisms



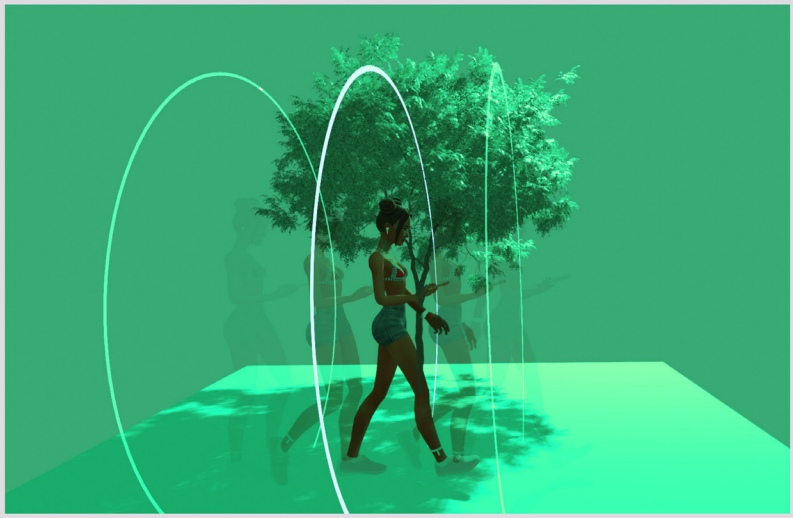

### 1. "Walk" of (Bank) Attention

Girl subliminally shifts attention from phone to body posture back to phone. The "bank" walked from phone to torso and back to phone over 10 frames (1 second, assuming 10 Hz).

Bringing the bank somewhere takes transient conscious control over otherwise autonomous processes, and "teaches" them via habituation.

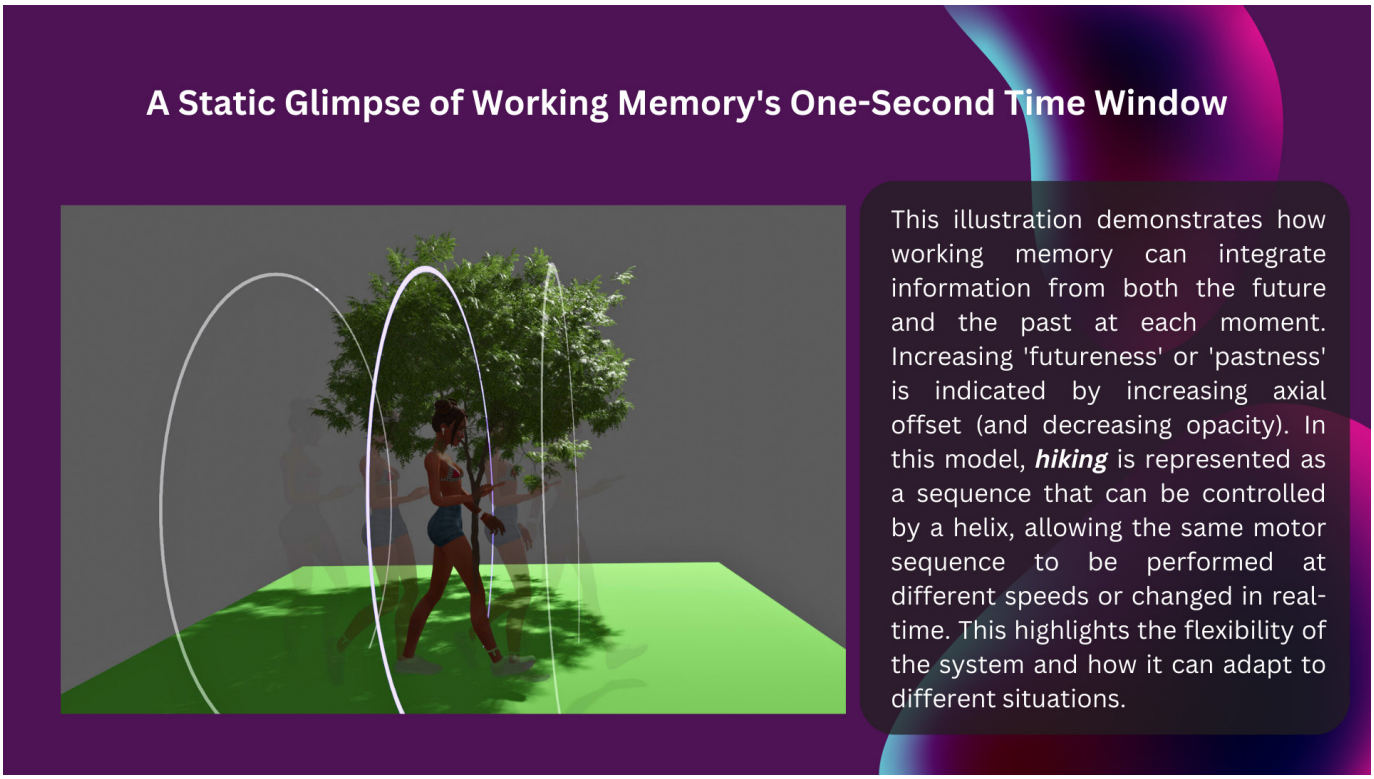
snippets or static 3D images, one could honestly consider the rings/helix/frames of consciousness as a similar fourth-dimensional hotkey tether or 'magic transitioner' that jumps into the fourth

## Frames of *Context* Resist Pileup: Spatial Offset Mechanisms

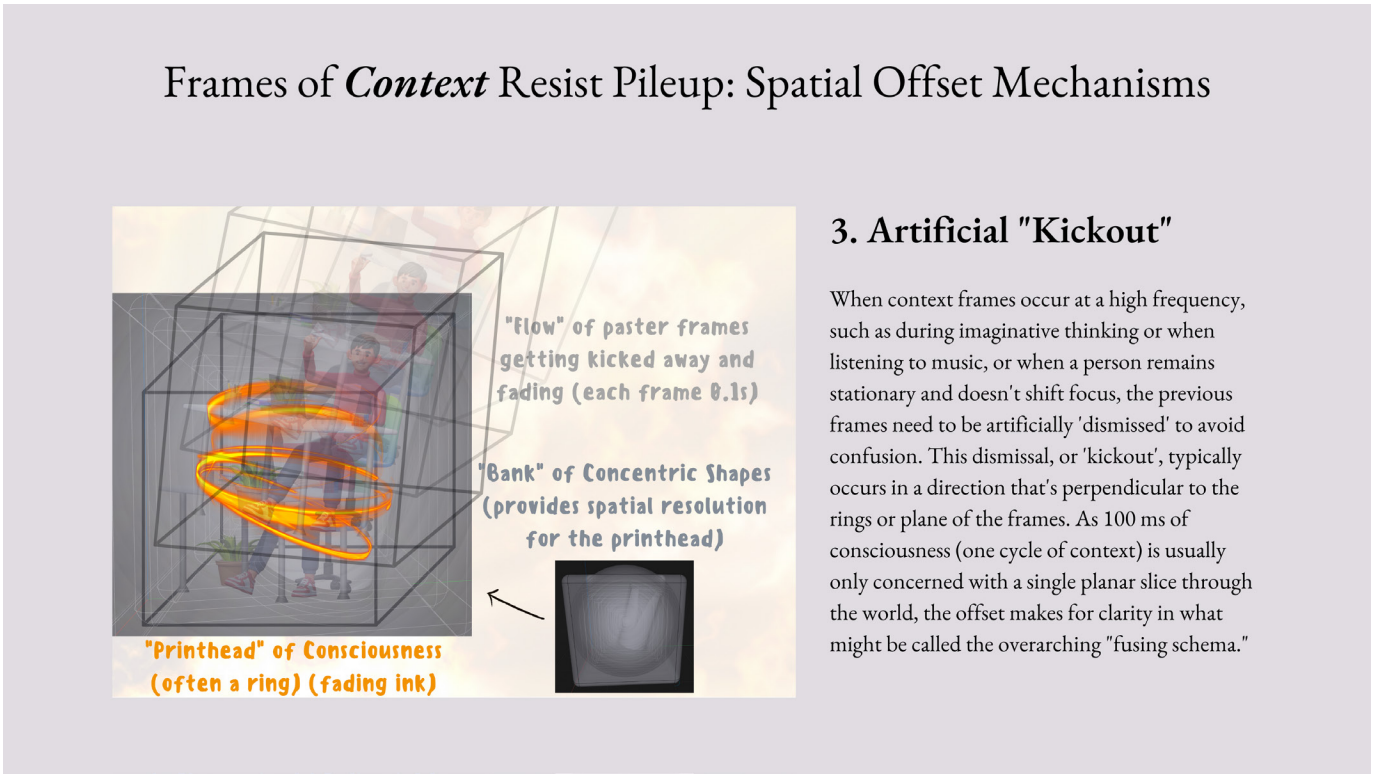


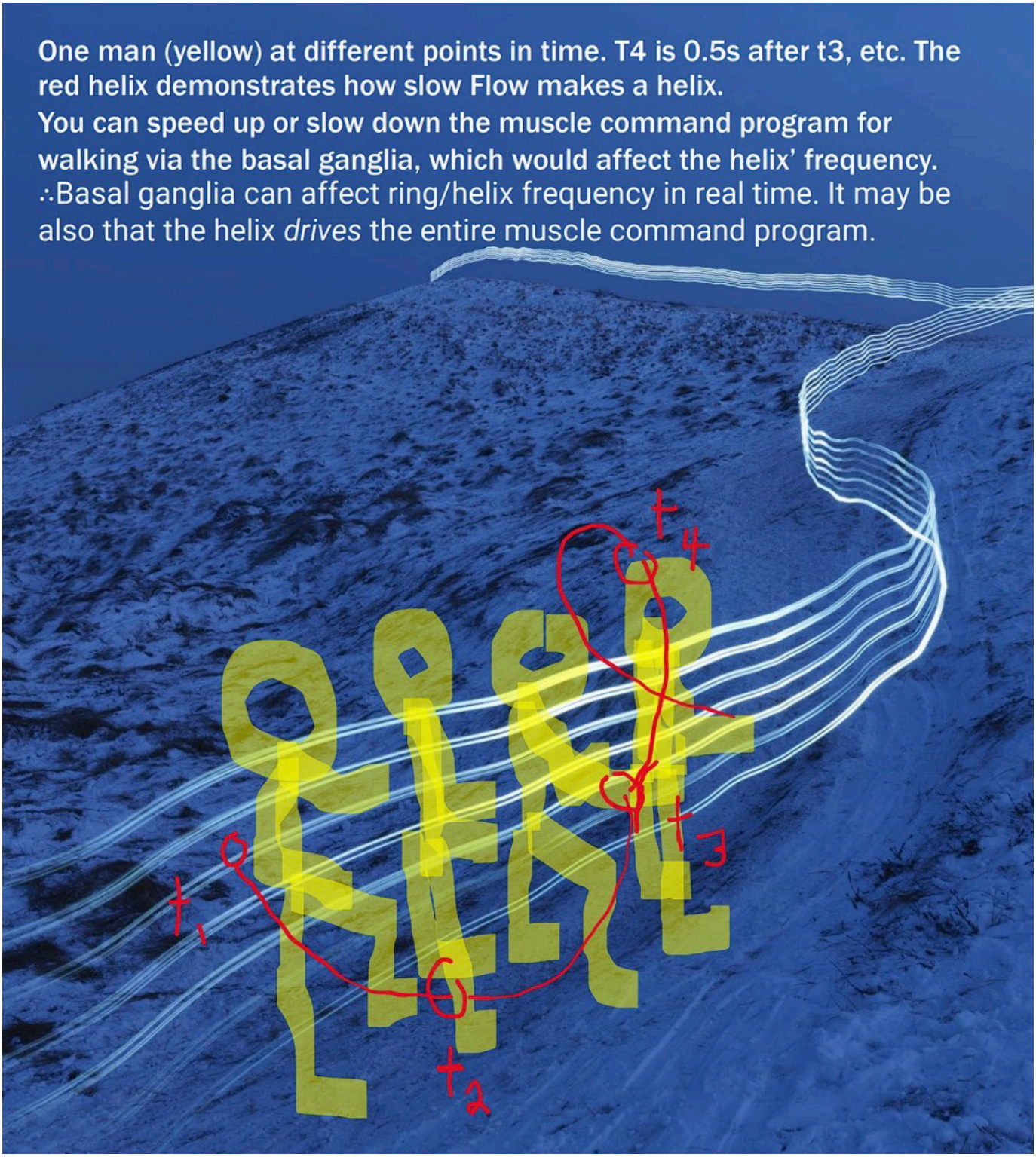
### 2. Self-Motion (i.e. Hiking)

Fusing schema lets self-motion cause environment schema to "carry" old frames backward exactly at rate of person walking forward.




dimension to get to these other 3D images. In this way, series of 3D images can be linked and stored as a motor sequence, thought sequence, music sequence, and so on and so forth.





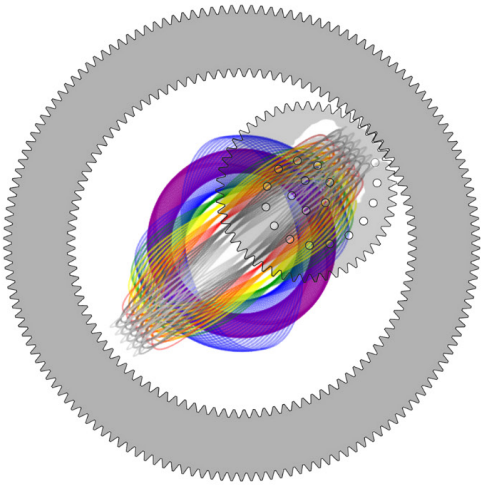

I've also noticed in the hyperpolarized state that certain words blow you away (the fourth-dimensional ring hotkey skewer has a huge, sudden increase in density of attached memories)—for example, the word 'Christmas,' or a last name—both of these I had to take a step back after

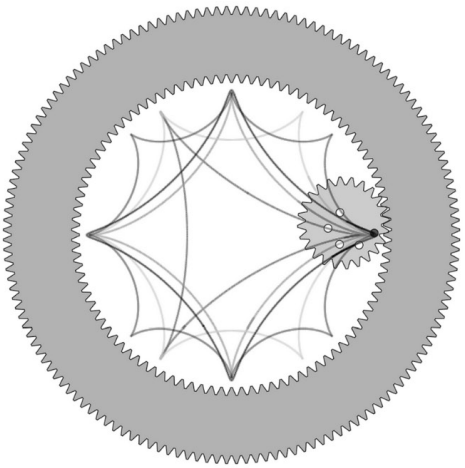
thinking them, and say, 'Woah that word has a ***ton*** of (memory) frames!' There are more layers in the chasm you look down through the letters of that word (thin onion skin layers underneath the visualization of the word if you will permit such a report from 'mere phenomenology')—the sheer complexity of emotion that can be built from looking down the chasm of one of those words can really blow you away! Words 'skewer' lots of memory frames together. So can *anything, however abstract!* Colors, combinations of color (filter by 'purple plus yellow' you get at least the LSU jacket and Mardi Gras, right?), you can filter by 'the exciting sound of someone getting home from work and opening the kitchen door,' and many memories of that are skewered together and it helps link 'you' together. Just take a memory frame of mental imagery depicting the person opening the kitchen door (and the vibrations of the ring within that frame give the sound), and that memory 'frame' has an associated 'onion layer' with the skewer going through it (and every other associated memory recollection) to hotkey, and you can then 'open' a layer (usually picked subconsciously) to peek at the mood inside, if even just for 1/10th of a second, or however long the 'video' or 'sequence save' of that frame is.

Sometimes you can 'hold' the frame you want to see as the ring is progressing, and slow the tracer slightly, and get a slightly longer 'play' of the video. To 'filter by' something, you need IDs for episodes, yes, but you also need categories—'likeness tables'—things to search by. I think the brain has categorization by many things—even hues of color, and it's like you can take a scrubber (like how you can fast-forward through iPhone photos), and as you change the hue from red-orange to orange, you pass through memories of objects you remembered with that color. This is not a function that is visible to normal-state consciousness, but one that has been repeatedly observed by numerous people in a variety of inducements of the hyperpolarized state (for example, one person noted this with ibogaine). It's also possible to categorize based on surface topology—for example, dried oak leaves may be saved to a similar region of bank where they can 'scrub' through and trigger other memories of walking through the woods, etc.

The cerebellum mostly uses long term depression (LTD) and down-regulates AMPA receptors on Purkinje cell 'brake pedals' which release inhibitory GABA on the deep cerebellar nuclei—the last stop before going back to the cerebrum. If you inhibit an inhibitor, you have a net increase. Perhaps certain instances of hyperpolarization affect the cerebellum and thereby reveal this categorization by topology mechanism. If you imagine traveling along the parallel fibers and activating certain Purkinje cells in rapid succession, linking to 'like' topologies, it's hard to resist the idea that the cerebellum is the site of the bank. But it probably isn't, as one can be 'fine' without it.

## Spirographs: Fixed Stator, Moving Rotor



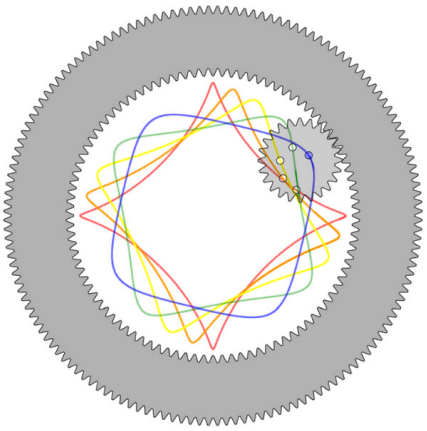


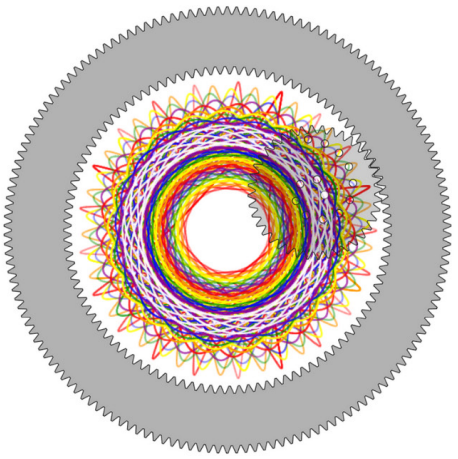
I will throw a completely speculative idea at you. What if point locations (for ring drawing) are helped or placed or mapped by having two copies of the bank act as a 3D rotor and stator—that is, like a 3D Spirograph? There is only one point location where the rotor touches the stator at any millisecond. I think it may be possible as a 'help,' but I do think there is some other mechanism to address each voxel of the bank, as it seems possible to have instantaneous understanding of an entire 'point cloud' in a single frame of consciousness, at times. Still, the idea is fun to play around with, at least for ring-operation.

So I should clarify that I don't know if this Spirographic method is always used in 'ring-mode,' but it seems to be used at least as a 'help,' sometimes. In the upper right image, the rotor (in each example) has a different revolution duration than the stator. In other words, the tiny rotor starts at one touch point—make a mark on both rotor and stator here. Then, after a little turning, the mark on the rotor hits the stator again, but it is a long ways to go before the rotor reaches the original mark on the stator.

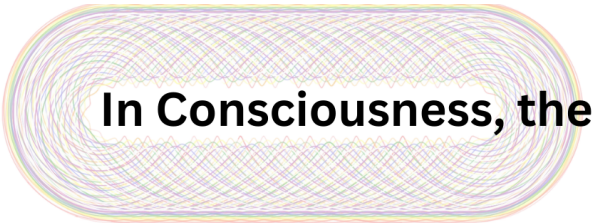
In fact, such 3D Spirographic movement may, as I have said before, just be a sort of 'bank default mode.' In other words, when you're not hiking or attending to anything in particular in your visual field, the bank might iterate over your space in this fairly haphazard manner. But note that it can quickly change to attending to things—if a car noise is heard, the bank rotor can expand size and

## Unequal Touch Frequencies of Stator vs. Rotor

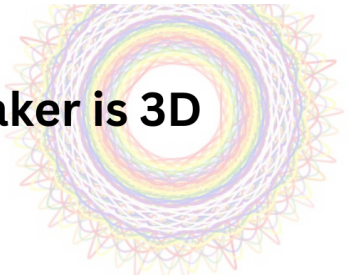


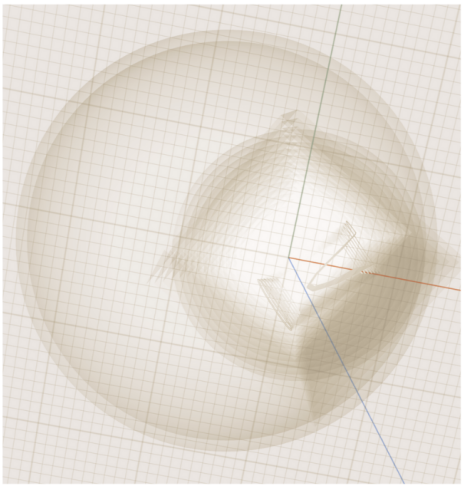


go over and 'refresh' experience's content there. I know that sounds weird, but I don't see any other way to convey this than in such terms. Another idea is—what if, during sleep, the rotor and stator



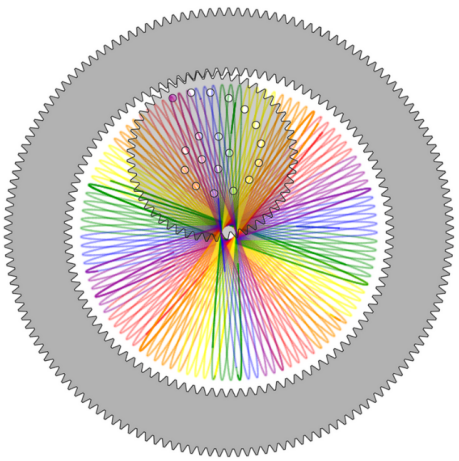
## In Consciousness, the Spirograph Maker is 3D





Whether the "dual frequency" mechanism is true, I still argue that the brain makes perceptual rings by rotating a bank copy against itself spirographically (expanded to 3D) - a sphere rotor rolls inside a larger sphere cavity stator (or smaller cylinder in larger cylindrical cavity). Assume there is no gravity, such that it can roll onto the ceiling with ease.

## Might the Brain Create the Ring via Reversing This?

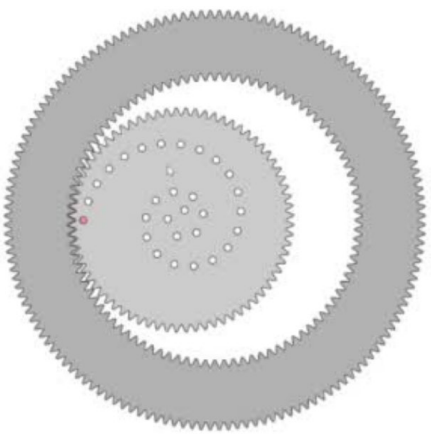


The idea is, what if theta represents the recurrence frequency of touching a point on the stator, and alpha represents the recurrence frequency of touching a point on the rotor? The difference in frequency could be used to "pretend" there is a perceptual space with a ring being continually traced out. Other regions of the brain could depict where this ring was declared to be in their schema, thereby aligning all the schemas.

change roles? In other words, the hippocampal theta can stay steady at 7 Hz. During wake, this could function as a stator relative to the faster cortical 10 Hz. During sleep, 7 Hz is faster than the

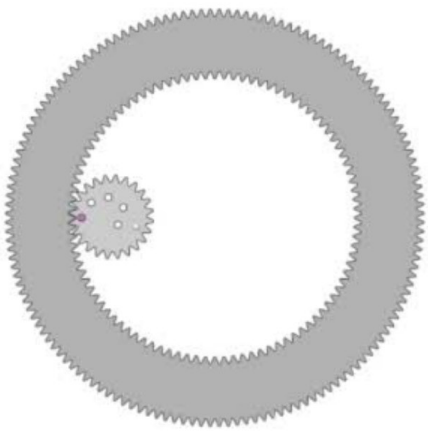
### Wake

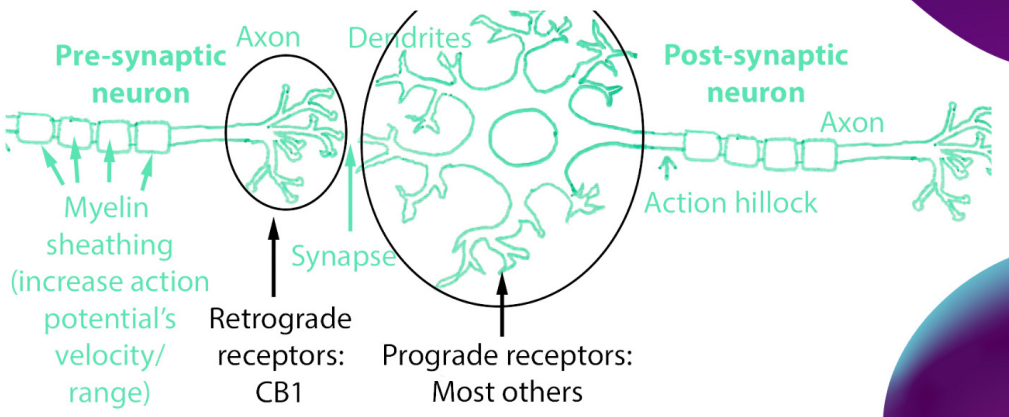
**Rotor**: *Cortical Alpha **10 Hz***
**Stator**: *Hippocampal Theta **7 Hz***



### Sleep

**Rotor**: *Hippocampal Theta **7 Hz***
**Stator**: *Cortical Delta **2 Hz***






cortical 2–4 Hz delta waves of sleep, and perhaps it now is a rotor relative to this slower frequency. In other words, you let the relative frequency differences 'pretend' there is this bank rotor and stator, and relative frequencies then have a 'traversing perceptual space' meaning. Whatever the case, sleep is something of its own realm, quickly forgotten upon wake, and people have suggested that there may be some kind of reversal of information flow encoding.

Perhaps hemp's THC, by binding to retrograde CB1 receptors, reducing the outflow of glutamate into the synaptic cleft, hyperpolarization of the post-synaptic neuron, and induction of the gap + burst (and slowed) firing mode is similar to sleep. Both NMDA-antagonists and GABA-agonists are said to induce a state akin to sleep, perceptually (and, given that we see 2 Hz, I'd say scientifically, too). The state isn't exactly like sleep, but there are similarities in the feeling.

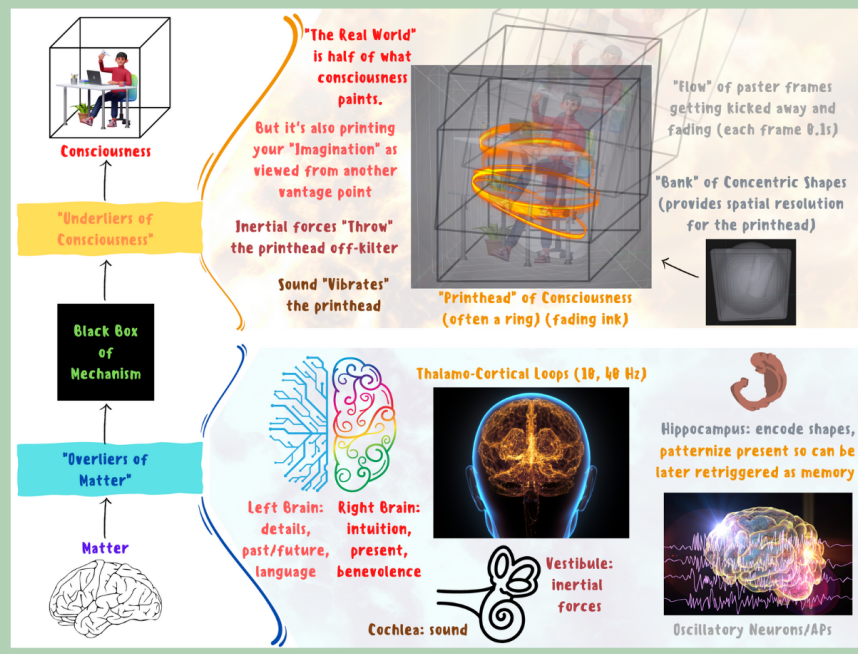
On the following pages, I have some slides depicting the various schemas and their proposed relations. On page 141, you will see an interesting concept—is it possible to have perspective without some up, down, forwards, backwards, left, and right of the viewer (which exists as a point for the model to impinge ray directions/colors onto)? I think, at least for our experience, our cyclopean avatar eye and our mind's eye both have these six directionalities. And if they do, perhaps that means they have a bank copy, centered on pupil, specifying those Cartesian directions.

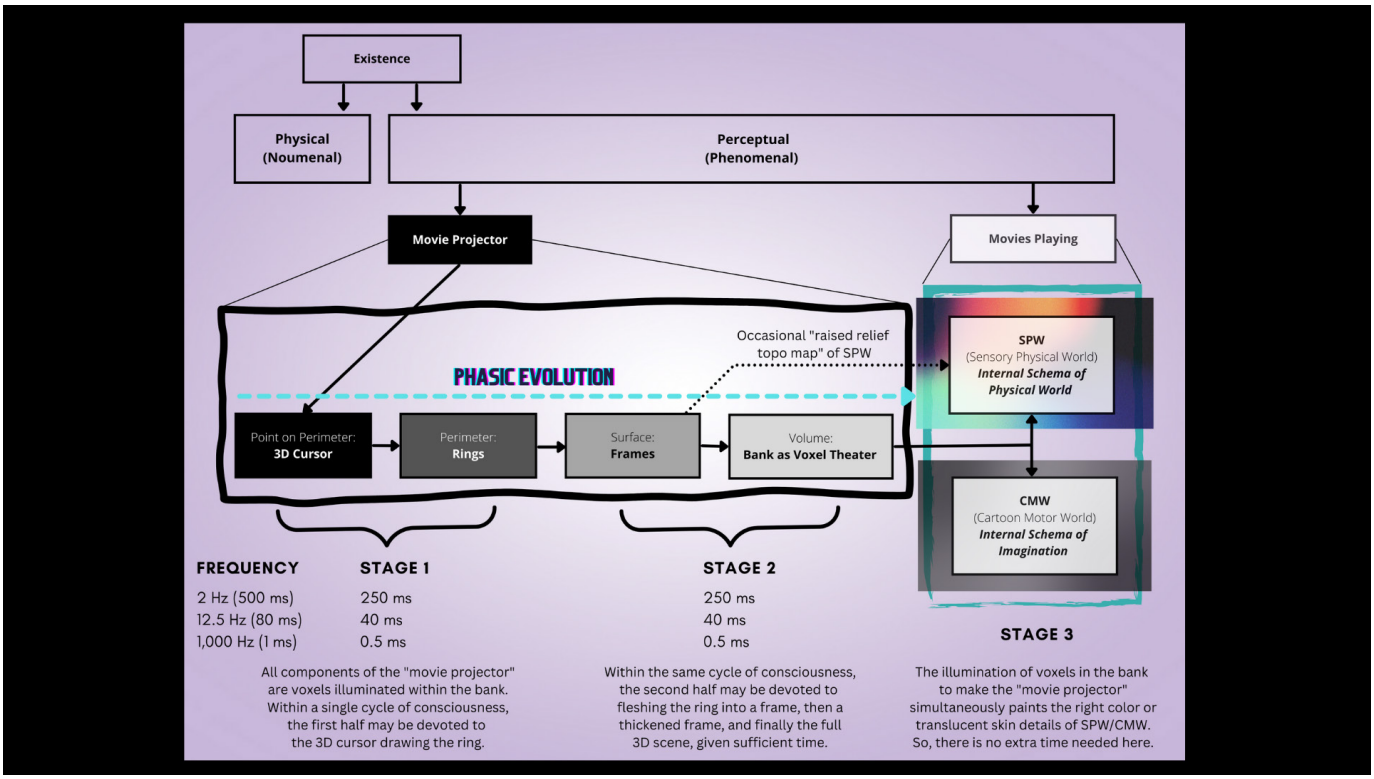

The terminology here may be a bit old, but I think you can grasp what I'm trying to convey in these illustration. 'Paint' generally meant 'pixel vectors,' whether colored or uncolored (imagination is

## The Role of Rings (Fusing Schema) in Brain Alignment

Introduction: The transition from matter to consciousness is a complex and poorly understood process. However, it is clear that the brain's architecture plays a critical role in this transition. One key aspect of this architecture is the role of rings in aligning activity across sensory, motor, and memory storage regions.

- Rather than thinking of rings as a "printhead," it may be more accurate to view them as alignment tools that ensure coherence and synchrony of neural activity. This alignment is critical for the formation of stable and meaningful representations, which are the building blocks of consciousness.
- Although the exact mechanism by which rings align neural activity is still under investigation, it is clear that they play a crucial role in shaping the flow of information through the brain. By providing a stable framework for the integration of sensory, motor, and memory-related signals, rings may help to bridge the gap between matter and consciousness.






often uncolored). The bank context is the portion that provides explicit 3D modeling (known prior to and apart from a viewer perspective, yet can be 'viewed' once avatar or mind's eye added.

## Two Main Components of Vision: Cyclopean Eye Schema (2D) + Bank Schema (3D)

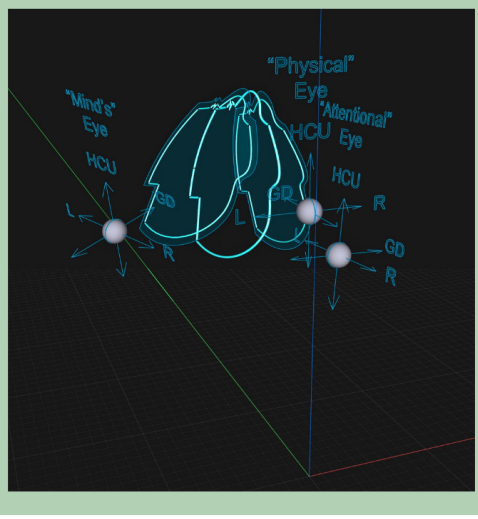
The human visual system is an incredibly complex network of processes that allows us to perceive the world around us. One way to conceptualize this system is to break it down into two main components: the *cyclopean eye schema* and the *bank schema*.

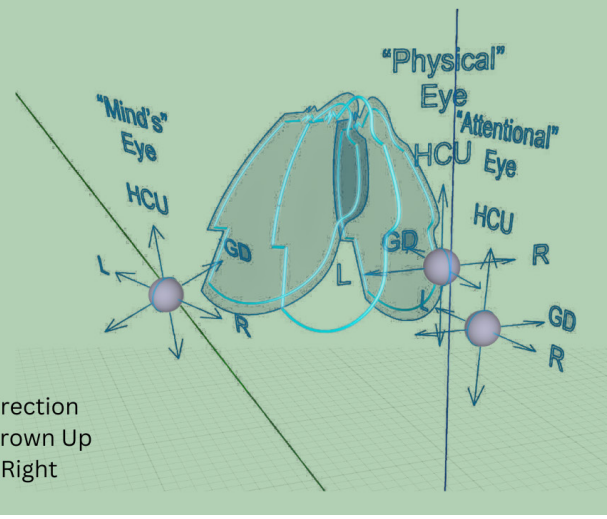
The *cyclopean eye schema* is responsible for detecting the orientation and color of rays of light that enter the eye. These rays of light are essentially 2D representations of the world around us. The cyclopean eye schema is able to process this information and generate a 2D representation of the scene, much like a photograph, or the curved back wall of a diorama. This 2D representation is the foundation upon which the 3D world is constructed.

The *bank schema*, on the other hand, is responsible for assigning accurate depth to each pixel in the 2D representation. It takes the 2D scene and creates a 3D model by assigning depth to each pixel, essentially turning them into voxels. This process is what allows us to perceive the world in 3D isometric form.

## Avatar's Cyclopean Eye and Mind's Eye Vantages

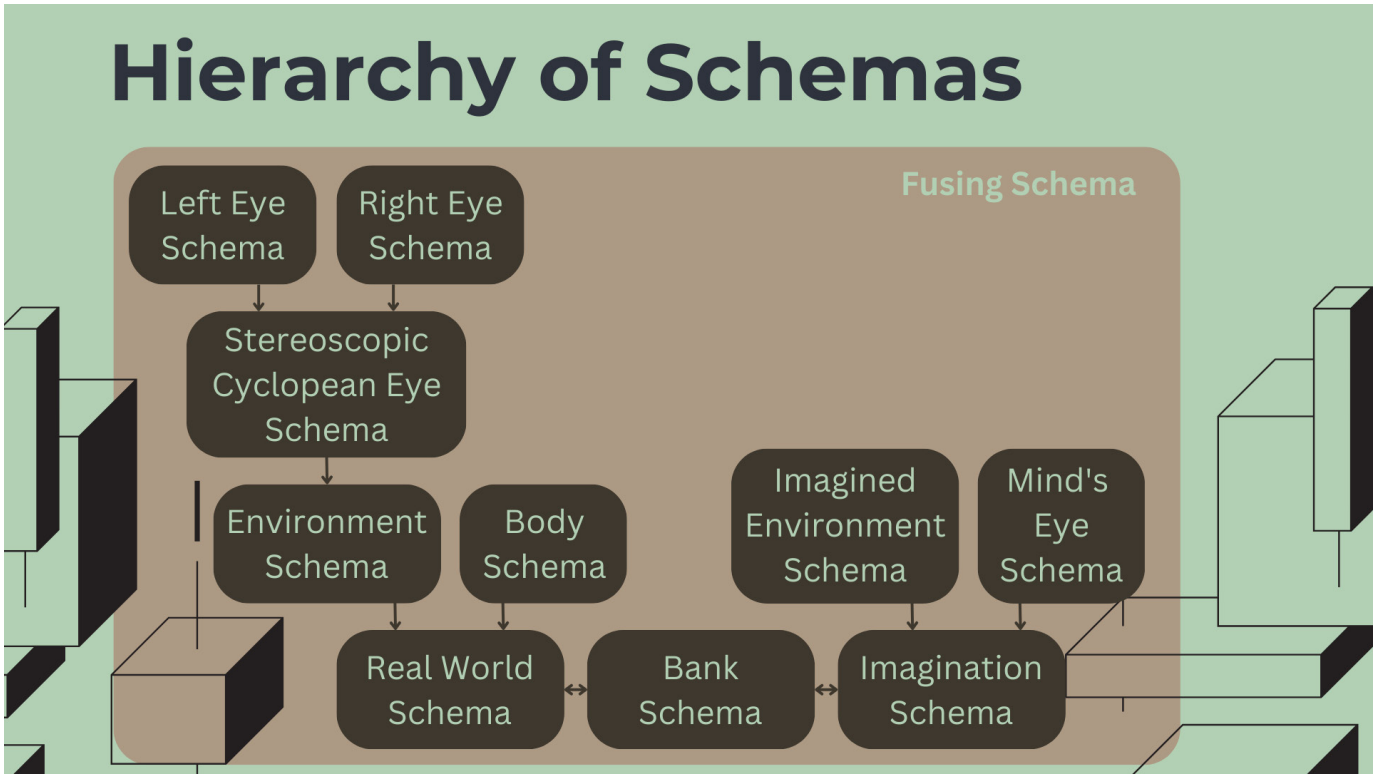
The avatar's perceptual cyclopean eye offers a specific perspective of the environment, which can be adjusted through changes in gaze direction or attention. However, the mind's eye allows for free rotation and orbiting around a focal point, allowing for more dynamic and flexible viewpoints. It's worth noting that any vantage point not only has a vector pointing towards the fixation point, but also maintains a "spin-locked" position with the head crown up (HCU) direction specified.

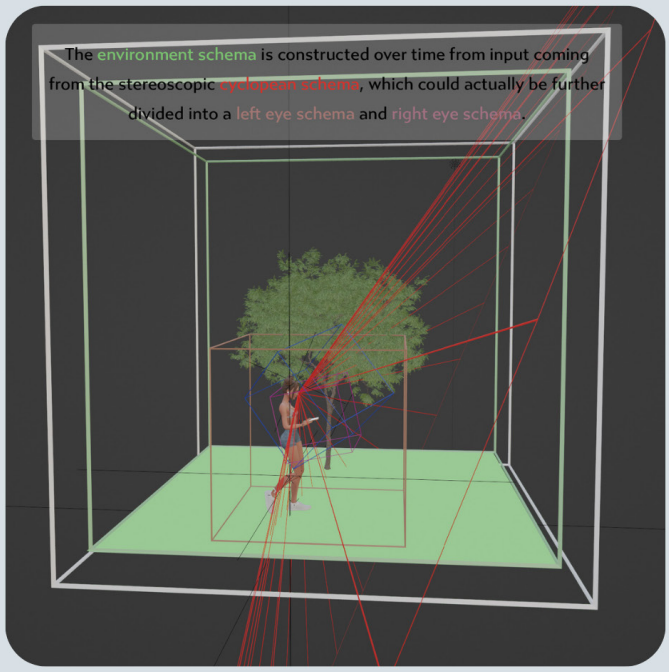



GD = Gaze Direction
HCU = Head Crown Up
L, R = Left, Right

The imagination and bank schemas can and do rotate in 3D, scale, and move relative to the avatar and environment schema. Even the avatar schema can be moving relative to the environment schema

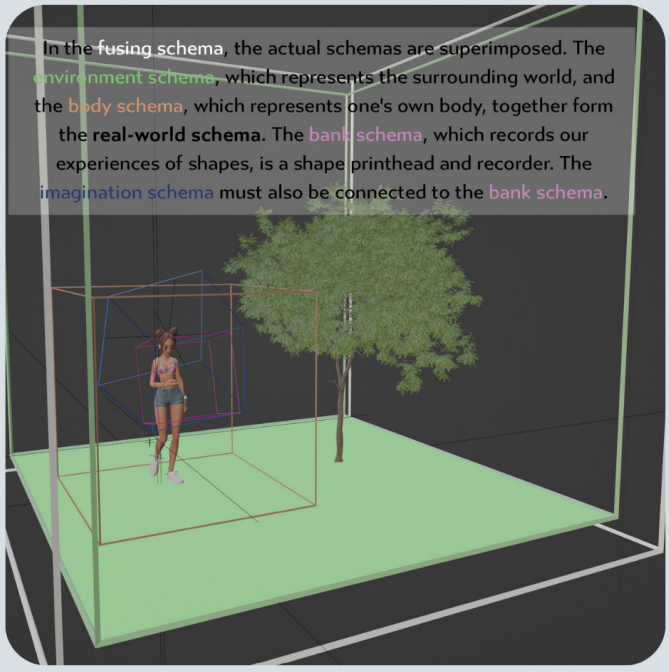





## Fusing the Schemas

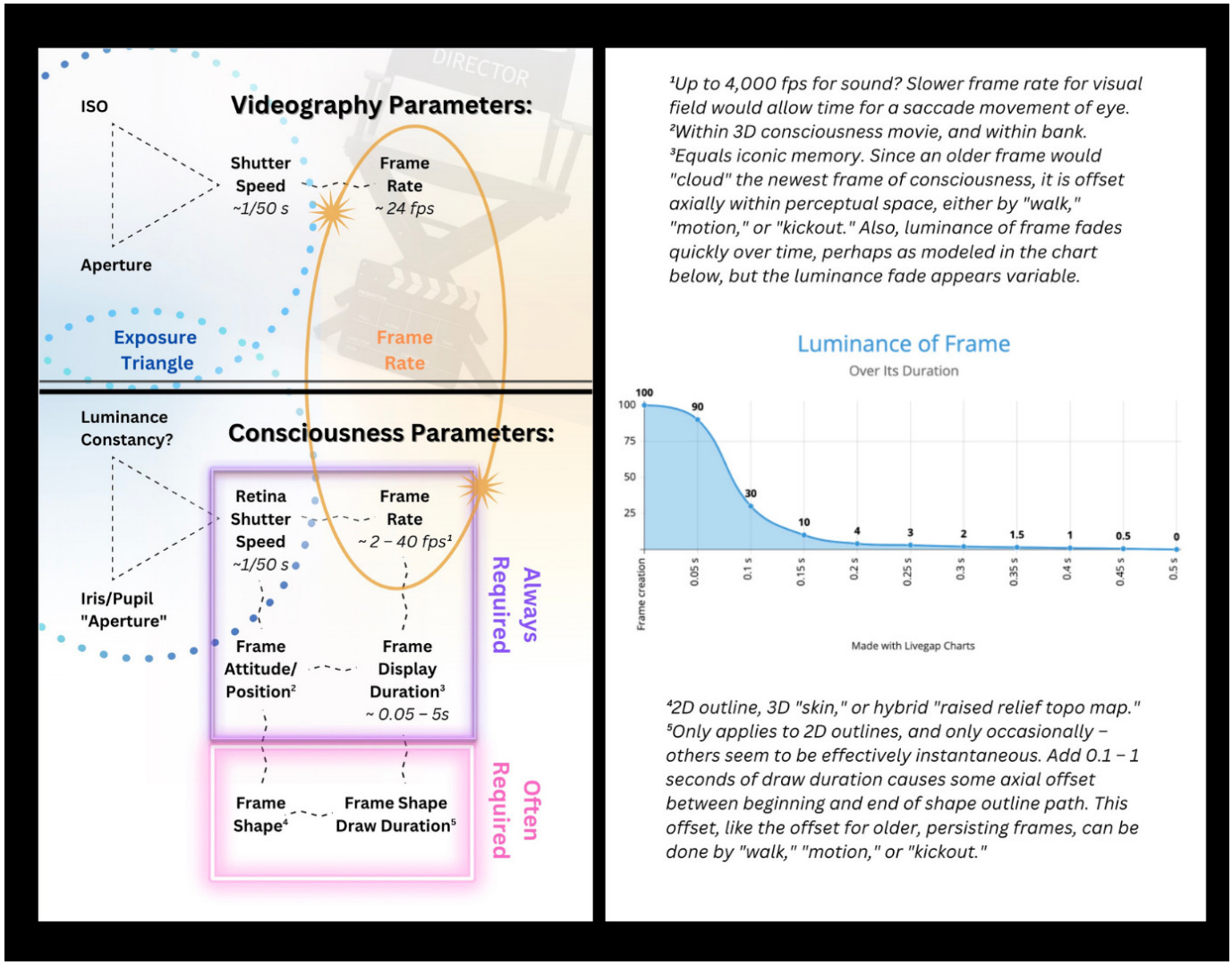
It should make sense now why the brain needs to keep track of the environment schema separately from the cyclopean eye schema, for the latter rotates with the head and eye movements, and is translating as the girl walks. The environment schema, however, includes things that need to stay fixed relative to each other, like the grass and the tree.

(or, better, vice versa, as I explained earlier about the avatar schema '3D pulling' the environment schema through its fixed space). By having a fixed avatar space, motor commands stand always




## Fusing the Schemas

Some schemas are here color-coded and shown as cube wireframes. As the girl walks, she moves her body schema relative to her environment schema. At the same time, her imagination schema and bank schema may be dynamically rotating and their content changing.

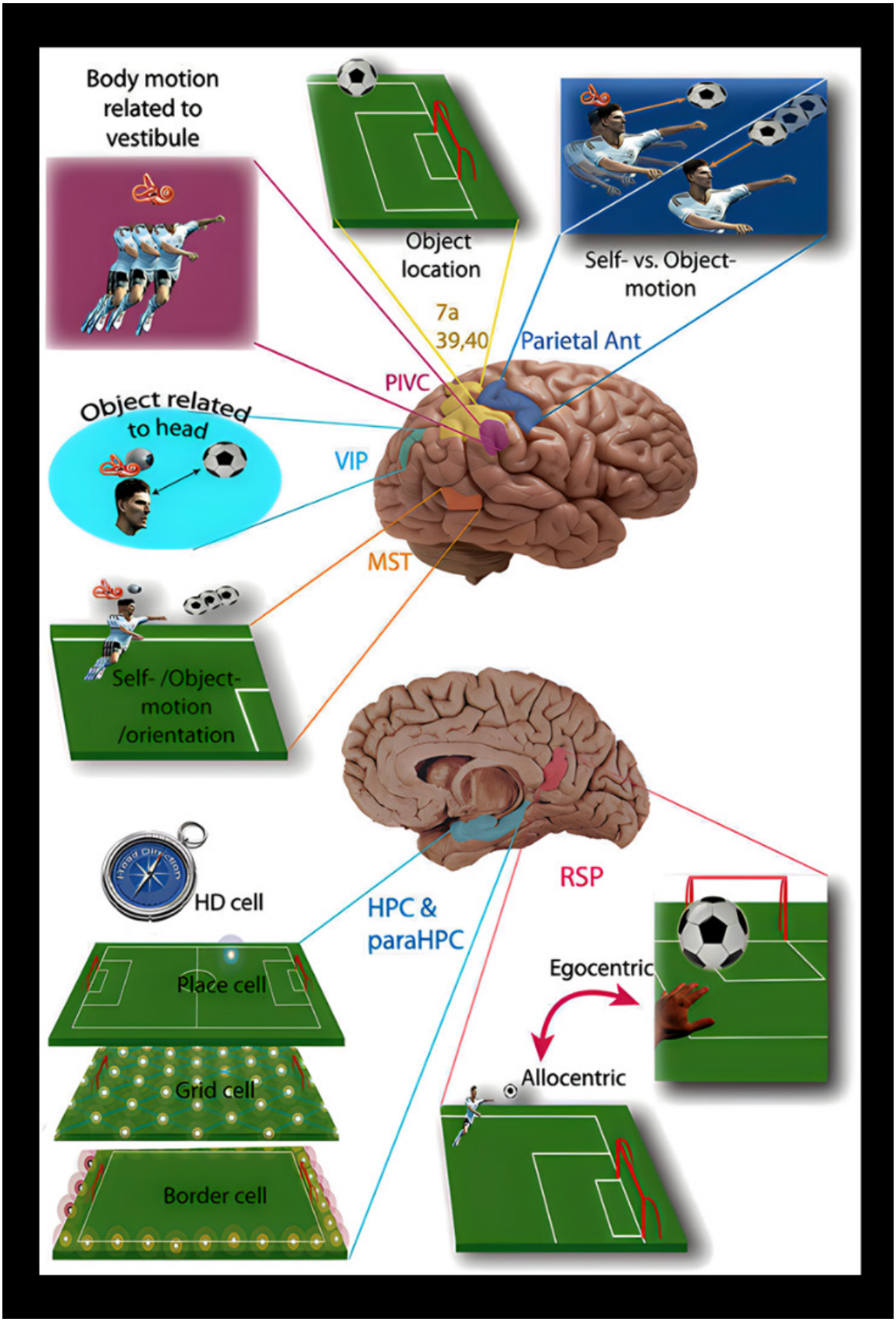



spatially proximal, and ready for implementation.

The image on this page is trying to illustrate how consciousness is akin to videography, but, being in 3D, extra parameters (which people usually don't think about) are necessary. In fact, 3D plus relative movement seems to fairly require rings/frame as a simple point of geometry, as is explored in the next image.

The image on the facing page[30] is from a study exploring allocentric (environment-centric), egocentric (avatar-centric), object-centric (the soccer ball), etc., reference frames given relative movement (and you can see the ensuing, necessary 'freeze frames' in the image [hello, rings/frames of consciousness—now a necessity?]), and the brain regions possibly responsible for aligning/computing.

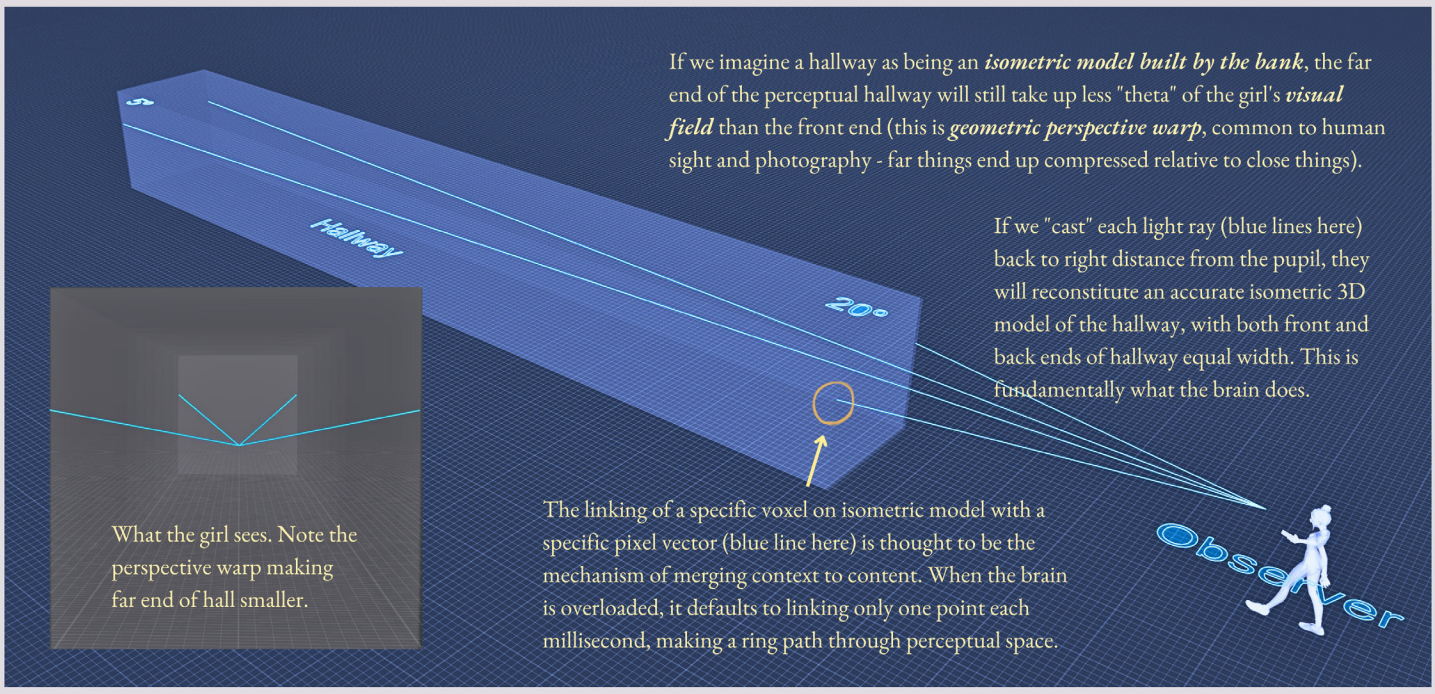
30 Hitier M, Besnard S and Smith PF, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0/>, via Wikimedia Commons.

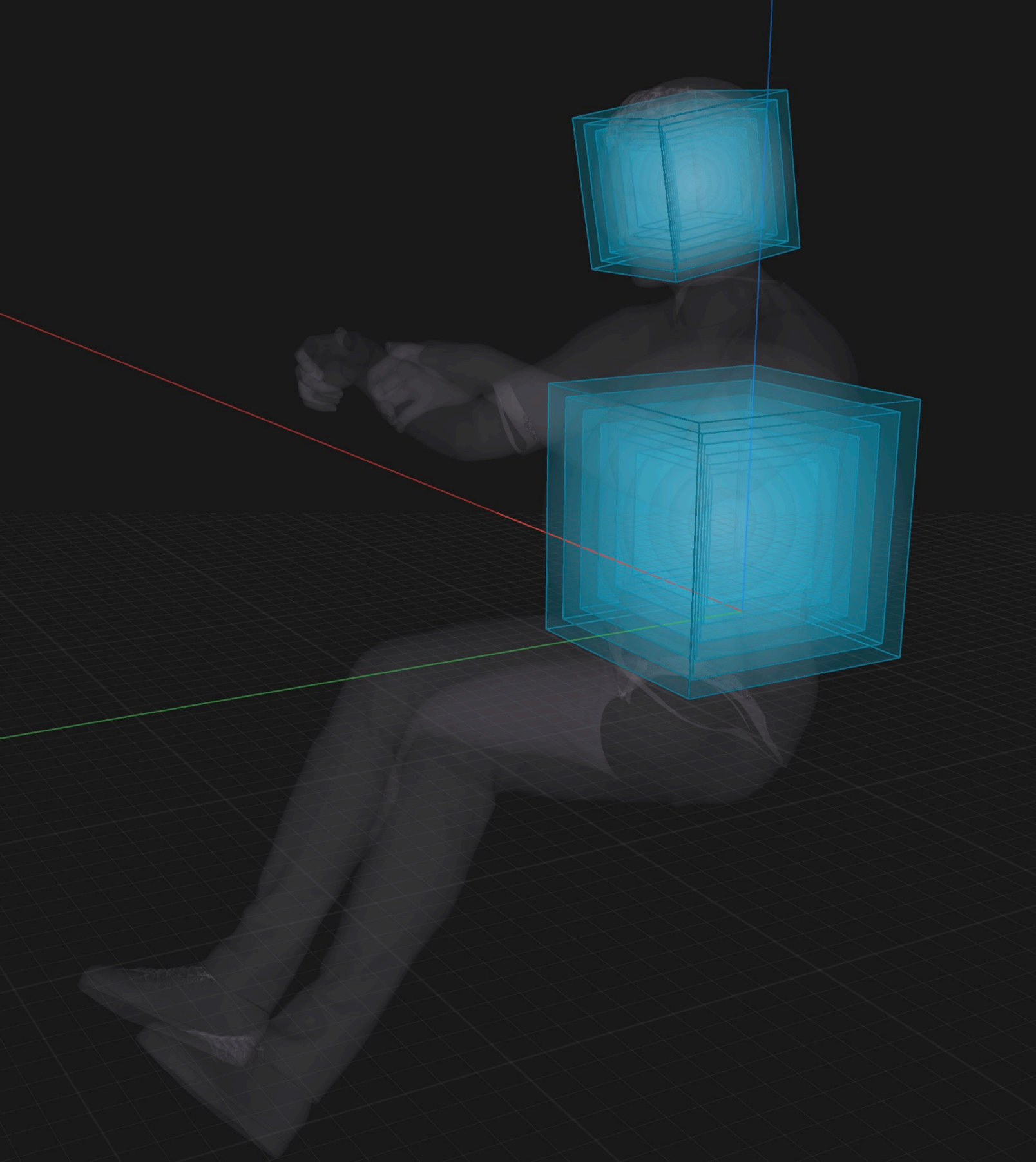

Body motion related to vestibule
Object location
Self- vs. Object-motion
7a
39,40
Parietal Ant
PIVC
Object related to head
VIP
MST
Self- /Object-motion /orientation
HD cell
HPC & paraHPC
RSP
Egocentric
Allocentric
Place cell
Grid cell
Border cell

It's extremely hard to see rings in normal state consciousness, but I have noted a couple ways if you pay very close attention. For one, when you first wake up and flash your eyes open and then closed, or when you are going to sleep and have eyes closed, you may note a 'flicking' or 'pulsing' effect at about 10 Hz (5–20 Hz). You may also note them in wake, if you are relaxed, lying down, with your eyes closed, and loosely attending to the ***locational*** shifts of your attention. Another way to see what I'm talking about is while listening to music. If you turn music up fairly loud, you probably won't sense the rings, but you may get little glimpses of what your imagination is '3D drawing,' (like the singer/band or concepts they are singing about). And if you turn the music off suddenly, you may at times be able to barely sense that the 'last note' is flowing off in some direction.

As a note, the bank has 'hysteresis,' like the loose steering wheel of a car. You have to move more than what you want it to move because it's lazy and moves slower and not quite as far as you do, and takes a few moments to go the last tiny bit. It would rather let 'paint' (the visual field) handle changes than it move the referential 'anchor' of itself. It's like it wants to be sure you're committed to the movement. Or, it may just be the laggy nature of frames relative to 'paint.' Contextual 3D modeling may take more brain resources, or may use neurotransmitters/receptors that include slower metabotropic receptors.

## Joining Isometric Context and Perspective Content

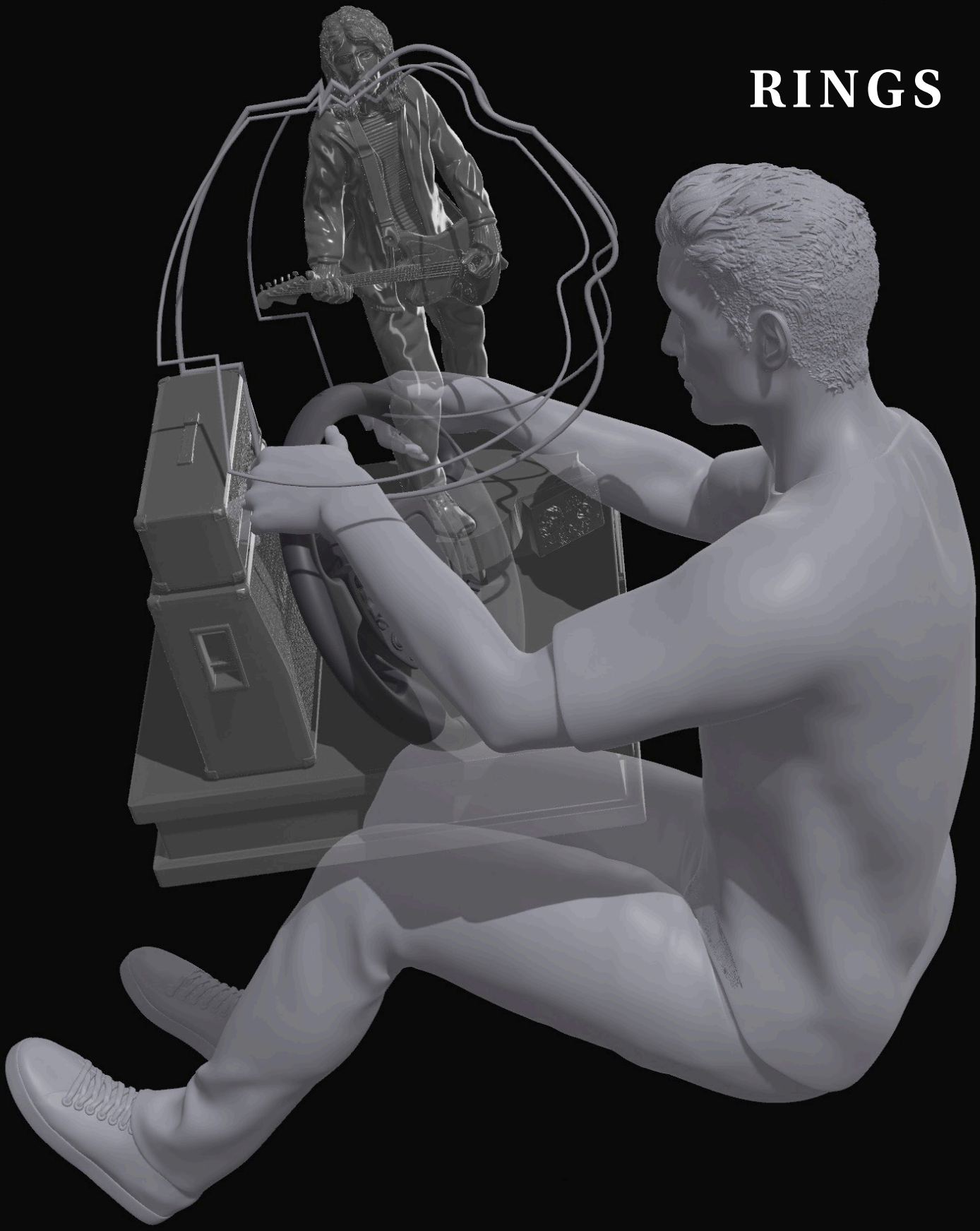




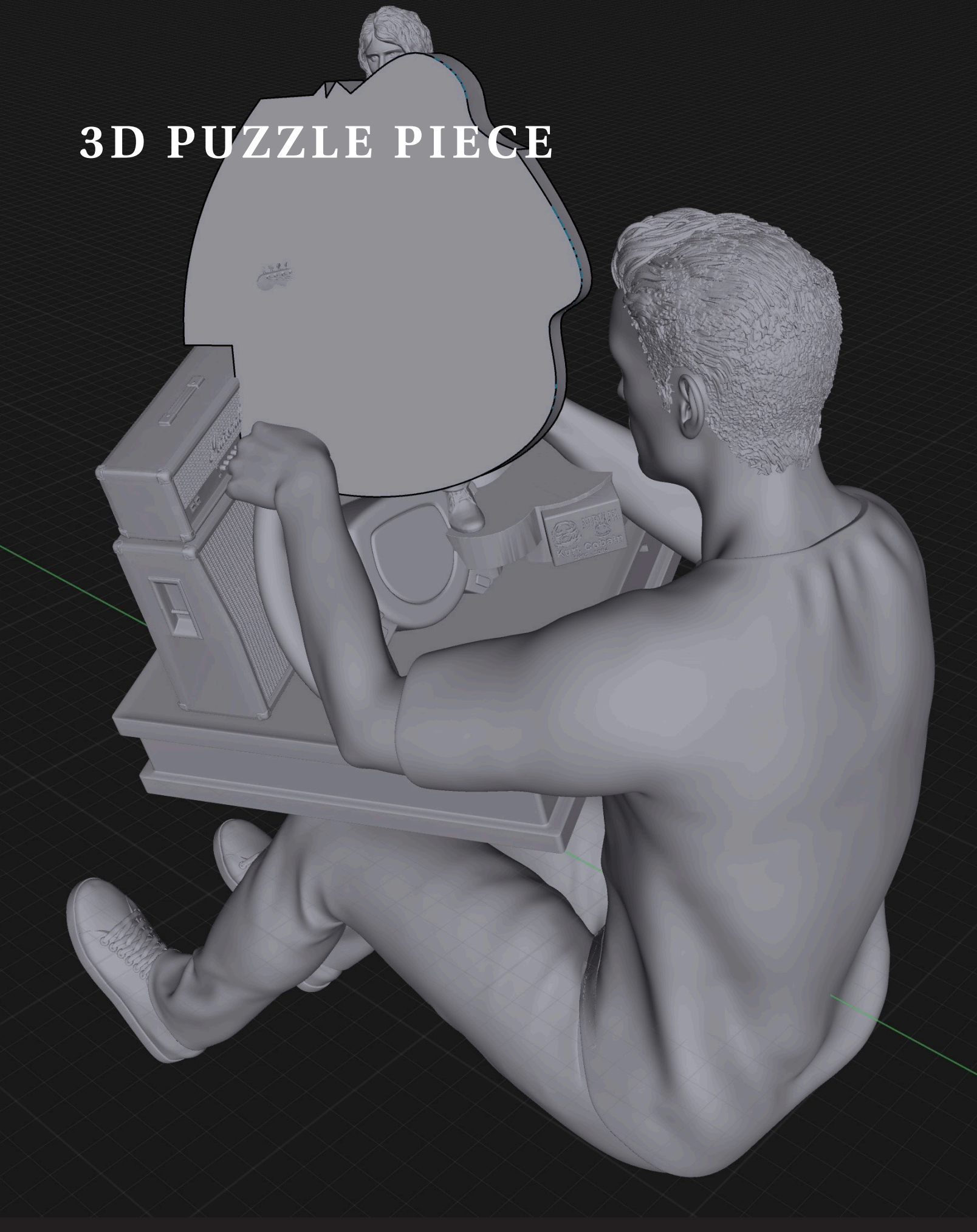
**HEAD AND TORSO BANK USAGE**

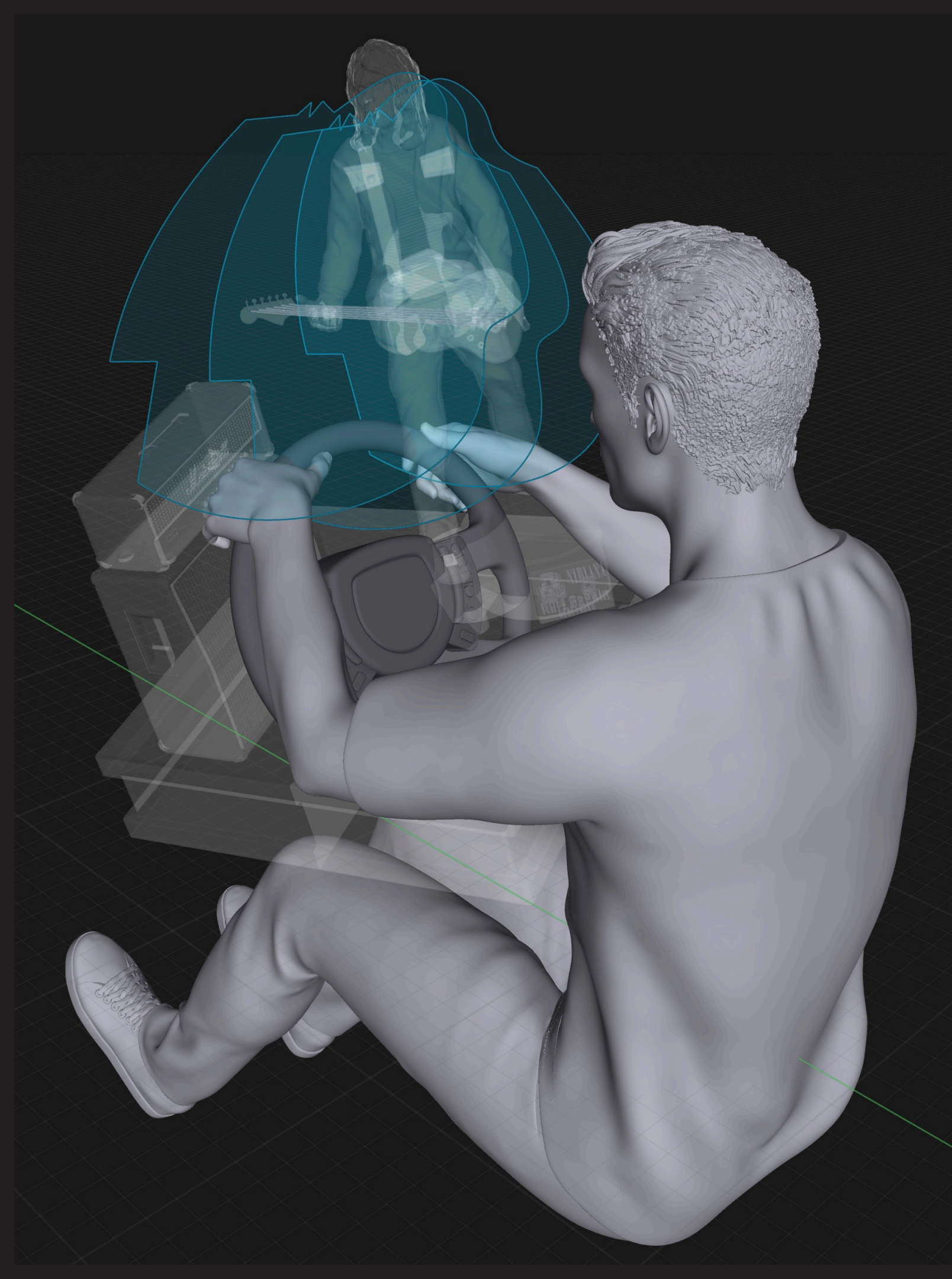
*The head—and the torso—can 'attract' the bank. That is to say, there is a 3D location that the bank 'settles upon' prior to using conscious control to adjust posture or tilt of head.*

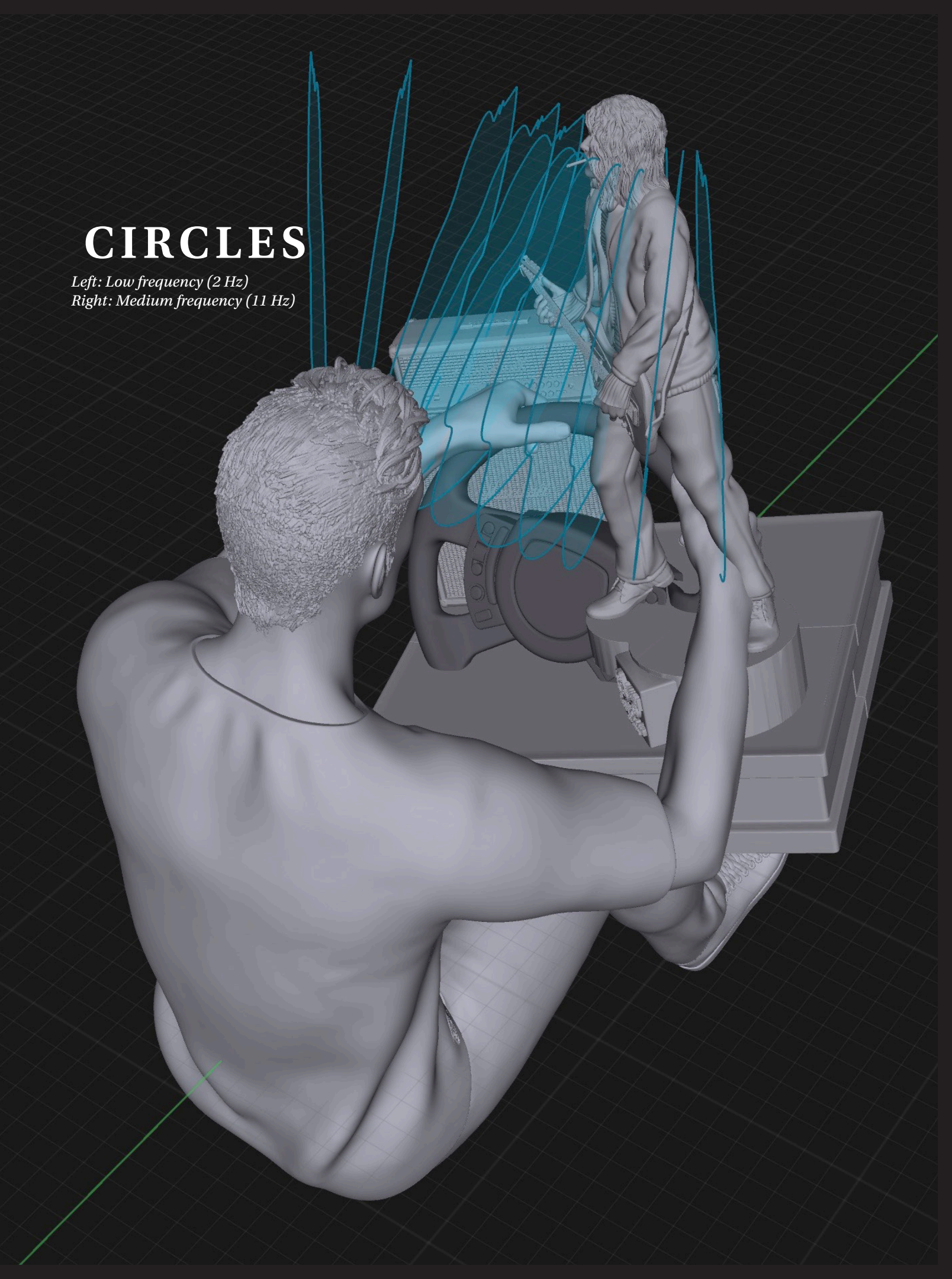
# RINGS

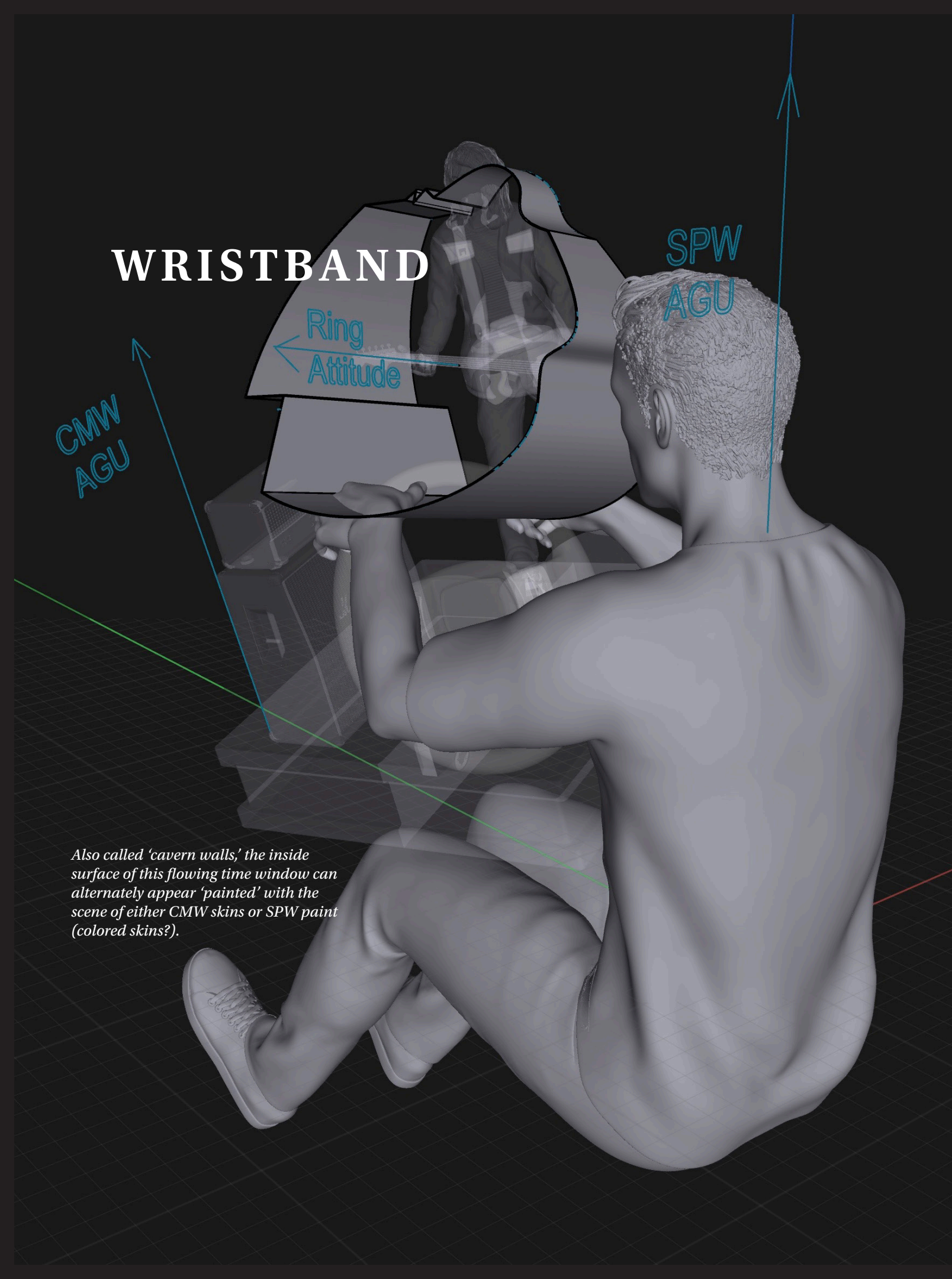


# 3D PUZZLE PIECE



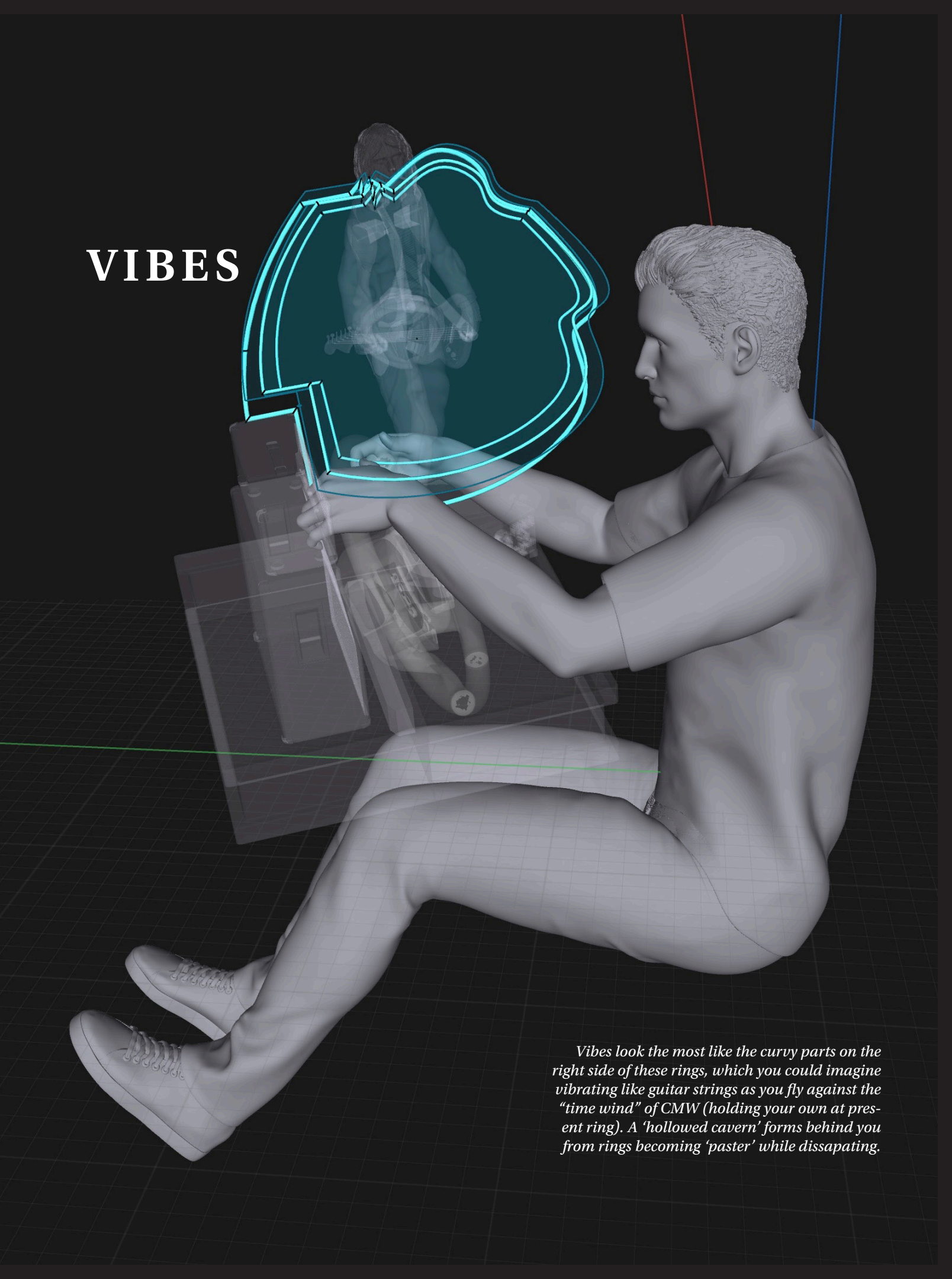



CIRCLES
Left: Low frequency (2 Hz)
Right: Medium frequency (11 Hz)

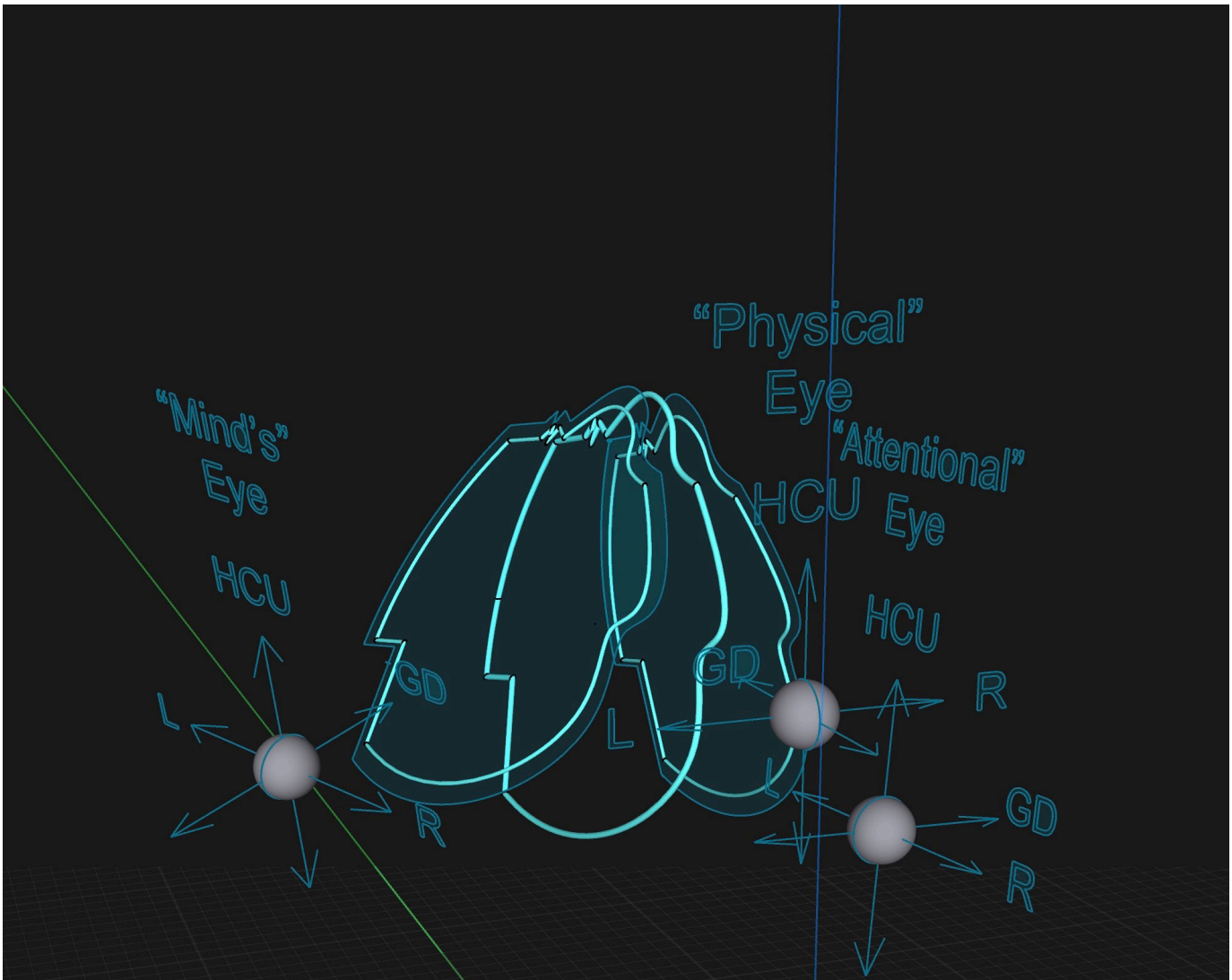



*Also called 'cavern walls,' the inside surface of this flowing time window can alternately appear 'painted' with the scene of either CMW skins or SPW paint (colored skins?).*

# VIBES



*Vibes look the most like the curvy parts on the right side of these rings, which you could imagine vibrating like guitar strings as you fly against the "time wind" of CMW (holding your own at present ring). A 'hollowed cavern' forms behind you from rings becoming 'paster' while dissapating.*




**THREE SEPARATE 'EYES'**

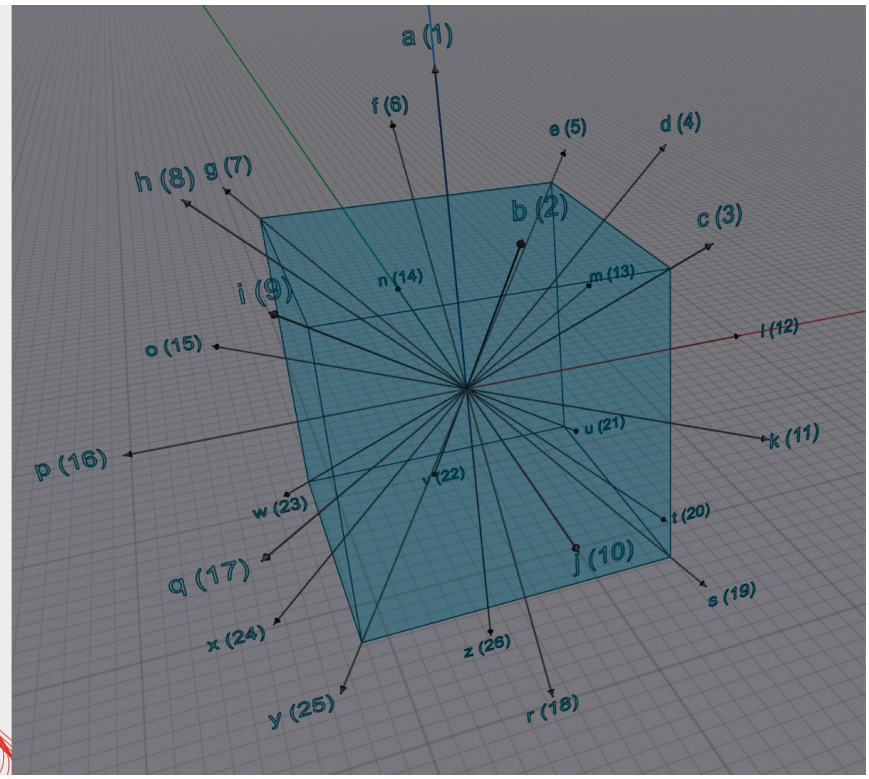
*GD = Gaze Direction*
*L, R = Left, Right*
*HCU = Head Crown Up*
*Spheres = Origin Points*

*You're probably only aware of your 'physical eye,' by which is meant the seat of the viewer of the 'real world' model made by the brain (SPW). But if someone starts talking to you at your right, and you are looking ahead still, an 'attentional eye' will look that way (your actual consciousness will have frames looking that way). Finally, when you 'day dream,' or get to thinking about something, you won't even realize that your 'mind's eye' has completely shifted away in origin from your eye and is looking at the mental image from a weird orientation and location. This is* ***not*** *the same as dissociation (actually, it may be, but mind's eye shift is thought to occur thousands of times a day).*

*CMW and SPW have been hidden from this view so as to make the 'eyes' more visible. In reality, 'attentional' eye's sphere indicating origin should perfectly overlap physical eye's (separated for clarity). Mind's eye really is offset.*

# 26 Handles

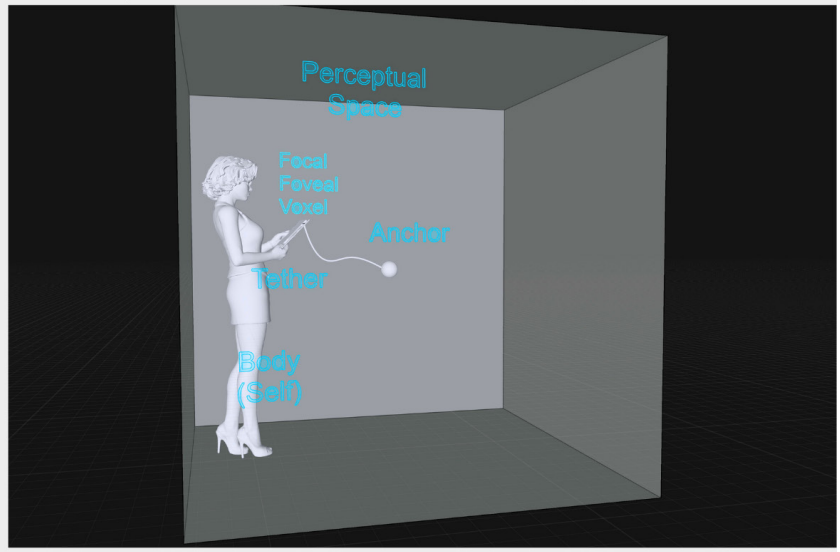
All 26 handles, or vector orientations, are depicted here. If we split the cube into 3x3x3 voxels (27 voxels), we could label each voxel with this same lettering or numbering system (center cube could be "origin," "." or "zero"). We could then subdivide again and again and reach 7 trillion voxels in 9 iterations. Any voxel within perception could be addressed with a "word" merely 9 letters long.

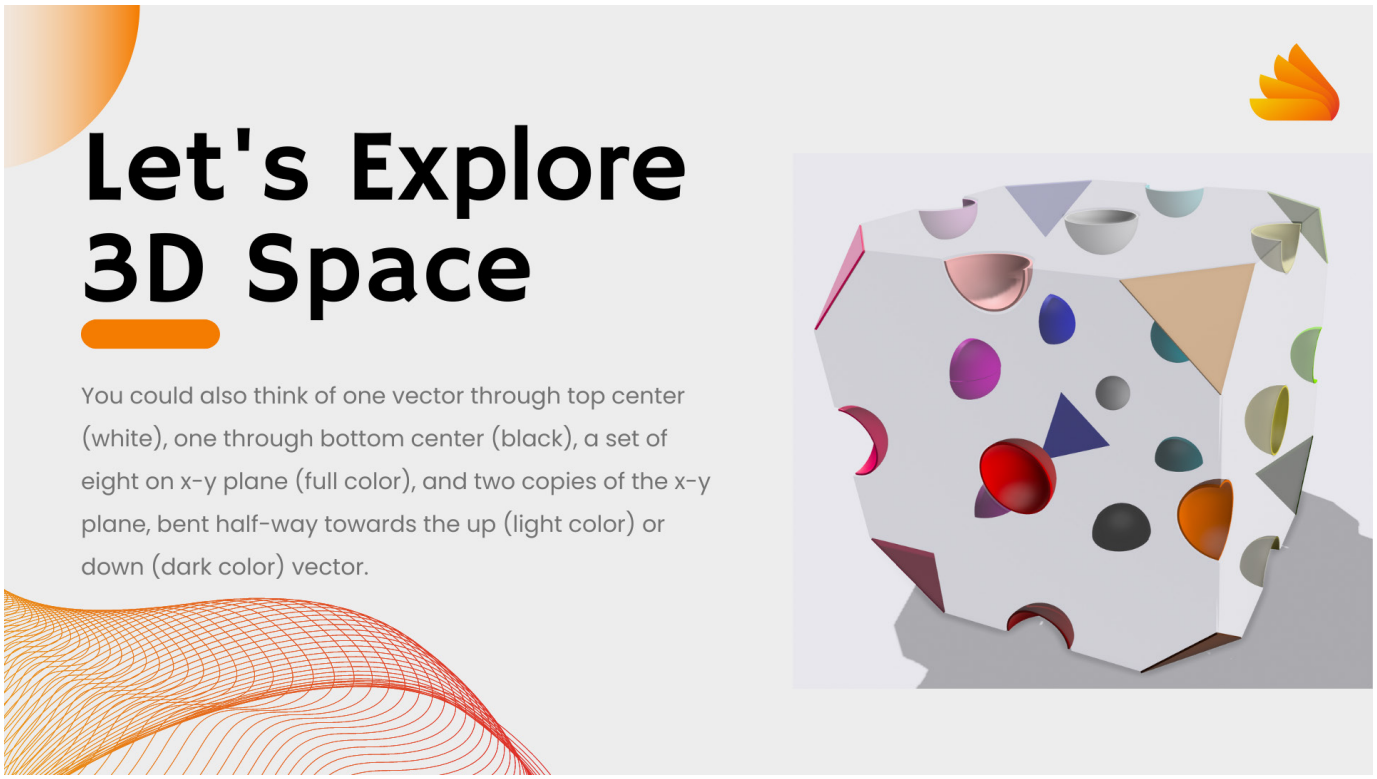



# A Trillion Voxels? (Base-10,000)

If the brain had an alphabet with a trillion letters, then any one voxel could be specified with a single letter. But what if, instead of using letters, it uses randomly selected sparse subsets of neurons? Statistically, this is entirely possible with fairly few neurons and with much redundancy (only 10% even need to fire if robustness built in) and little chance of overlapping false positives.

## 10,000 x 10,000 x 10,000






I started my journey into consciousness by wondering how perceptual color is made. By now, I feel like I am close to understanding how everything else in consciousness is made, but not color. But if I had to take a stab at it, I'd guess that it is either painted or triggered by the very tiniest, highest-frequency locational perturbations of the tracer making ring paths. If so, perhaps light to dark would be one axis, and the rainbow would be 0-360º around the plane orthogonal to light-dark, as playfully illustrated above. Color seems to be drawn or encoded by invisible (subconscious) helpers, and, with a little 3D-rotation of ring attitude, that work can be 'extrapolated' or 'cast' from the rings spherically around, as full 3D sweeps across, made from these colored pixel vectors, perhaps in a sort of axial-pointing '>' shape.

Whether or not color is encoded by 3D-directional vibration, it is a fun way to illustrate 26 vector directions in 3D space. In fact (preceding page), learning 26 vector directionalities in 3D space wouldn't kill us. We always tend to think in 2D, even though we don't recognize it. Understanding some extra 3D directions could be quite useful.

As a final speculation, what if every cortical column has a 'copy' of the bank, in the sense that some 40 neurons within each column serve as the 'letter' to one of a trillion voxel points on the bank. Neighboring columns could learn, for each point, which 40 neurons of their column corresponded with which 40 of the others. Or what if every cell has a copy, with 40 sections of non-coding DNA encoding each voxel point of the bank?