

An Art to be Learned

BY

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Doctor of Philosophy in English
in the Graduate College of the
University of Illinois at Chicago, 2011

Chicago, Illinois

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This dissertation is dedicated to Madeleine Monson-Rosen, who provided feedback, support, and sanity during its composition.

ACKNOWLEDGEMENTS

I would like to thank my dissertation committee—Christina Pugh, Mark Canuel, Jennifer Ashton, Eugene Wildman, and Richard Jones—for their support and assistance during the composition of these poems. I would also like to acknowledge Anne Winters, who served as my committee chair for the first two years of this project’s development, and Nancy Cirillo, Mary Beth Rose, and John Huntington. I am indebted to all of these mentors for their guidance and support, both in my studies and in my professional development.

I also had the good fortune of being surrounded by peers who were willing to spend time and effort reading drafts and offering feedback on this work. I am especially grateful to Chad Heltzel (who read these poems as carefully as his own), Madeleine Monson-Rosen, the various incarnations of my writing group (Chad, Brandi, Addie, Matt, Jay), and Todd Thompson who guided me to the work of P.T. Barnum, the model for the voice of Dr. Bunting.

I am also grateful to the Ragdale Foundation in Lake Forest, Illinois for the time and creative environment they provided during the summers of 2009 and 2010.

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SUMMARY

These poems resurrect the often obscure histories behind scientific accomplishments while simultaneously seeking links between poetic and scientific vision. Individual pieces present moments of discovery that humanize the people who have pushed the boundaries of knowledge. Through lyrical narrative, these poems demonstrate how the forces of history can be seen interacting on the figures presented, emphasizing the way scientific discoveries are framed by the contemporary moment. I also attempt to convey the imperfections, quirkiness and ultimately the humanity of these discoverers so that science is revealed as an imaginative, and often imperfect, process.

Bone Wars

During America's Gilded Age, the railroads were opening up the West and paleontology was a science in its infancy. Edward Drinker Cope was a gentleman naturalist in the tradition of Jefferson and Franklin. Othniel Charles Marsh attacked paleontology like a Robber Baron, trying to establish a Trust to keep competitors out of the fossil beds he uncovered. These two scientists were at war for thirty years: racing to discover and name prehistoric animals, slandering each other in scientific journals, and even destroying fossil beds to prevent the other from making finds. While they made many significant discoveries, their ambition also resulted in many errors. It would take future scientists over a hundred years to find and correct all of their mistakes.

I.

On the floor of his conservatory, circled by ancient bones, browned bones, bones knob-tipped, ribs like dried wooden planks, dorsal vertebrae unpacked from crates shipped to Philadelphia by rail, Edward Drinker Cope constructs a Kansas prairie bathed in a warm sea full of ammonites and belemnoids, where this Elasmosaurus propelled itself through salty waters with a huge tail, dinoflagellates blooming bioluminescent clouds of light in its wake. From fossilized phalanges spread like puzzle pieces, structure emerges— analogous to a whale’s speared flipper or the fingers of a giant wing. Cuvier once boasted that from one bone the entire skeleton came alive, as if even a knuckle could be the verb of its sentence; Cope believes this: deep time awaits translation, etched in a canyon wall, millennia compressed to a glance. But when the public gathers in Philadelphia to admire the assembled monster, Othniel Marsh exposes the vertebrae as reversed— *like Barnum’s famous woolly horse, the head was where the tail should be.* Elasmosaurus swam with flippers, lofted a serpentine neck twenty feet above the sea.

II.

July 1870. A rising sun flairs the prairie grass, and from Ft. McPherson Othniel Marsh begins his expedition—his students in their oversized Stetsons, a caravan of wagons and the Fifth Calvary as military escort, two Pawnee galloping ahead, scouting the horizon for Sioux. Even Buffalo Bill Cody rides beside them for a day, trading tall tales with the Professor from Yale. Marsh takes the field with a geologist's hammer hanging from his belt, a cavalry carbine over his shoulder, twin navy revolvers holstered on his hips. Tucked in a saddlebag: a stonemason's chisel; rock saw; a brass-handled shaving brush he bought from a barber in New Haven, its horsehair bristles gentle and accurate in the dimples and craters of fossilized bone; a pouch of flue-cured Virginia. In the other saddlebag: a chipping hammer; his father's leather-sheathed fishing knife; a magnifying glass that belonged to Ezekiel Jewett, the geologist who trained him to distinguish the brass hue of pyrite from the peppered rice of dolomite and to sharp shoot a squirrel from twenty yards. They once found a shattered egg washed up on the banks of Lockport Canal. Marsh picked through the mud, cleaned each watch-screw bone in his mouth and restored an embryonic turtle, the entire skeleton cradled in the palm of his hand.

III.

Annie,

I have a breathing spell here and improve it to jot down some of my doings and talk to thee and Julia whom I wish so much to see. By noon we reached Miss Collins' house at Little Eagles' settlement. Her mosquito bars made life endurable. As it grew late we climbed a low bench at the foot of an opposite hill. I saw lying around white objects. Sure enough the ground was covered with fragments of Dinosaurs, small and large, one could hardly walk without stepping on them. I fixed up a shelter away from the wagon, as I don't like to sleep near so much iron when lightning is flashing and retired to dream of Dinosaurs except when thunder and mosquitoes woke me. I remembered the Indian legend of the place as narrated to me by Miss Collins. The Sioux knew of it long ago, but they believed the bones belonged to evil monsters which were slain by lightning. They would not touch the bones for fear that a like fate would befall them. So they were preserved for the more intelligent white man who is not troubled by such superstitions. But the Indian might have found support for his opinion, if lightning would furnish it. It played across the sky in forked streams, descended to earth in blinding bolts. But it did not avenge the disturbance of the bones, and we dug them up and boxed and shipped them as far as this place. Miss Collins has quite a taste for Natural History, she has a collection and a library. She received us very hospitably and kept us all night.

Edward D. Cope

IV.

The Loup Fork River carves into white cliffs, and the Pawnee scouts refuse to help Othniel Marsh and his Yalies gather fossils—tremble at the Sioux legend of an ancient race destroyed by the Great Spirit, their giant bones scattered across the badlands, burnt into rocks. To disturb the remains would provoke a similar fate. But Marsh soothes the mane of an Indian pony, and with a fossilized jawbone shadows the curve of its head, demonstrating how shapes imprinted by the dead are but a forgotten synonym of the living. Convinced, the Pawnee finger the wet clay, bring this *Bone Medicine Man* his camels, his rhinos, mastodons, and new species of horses. On day four they come upon Sioux burial platforms lofted on six-foot stakes, branches a canopied ribcage arched over the dead. Marsh hoists himself up, investigates the bodies—a woman adorned with bracelets and beads; a scalpless brave marked by war paint, a rusted rifle and playing cards clenched between mummified hands—and claims their skulls for his collection at Yale.

Dinosaurs in Central Park

From iron, from clay, Waterhouse Hawkins constructed the prehistoric diorama for London's Crystal Palace—muscular Iguanodons, Megalosaurus shouldered like a lioness, crocodilian snout. Queen Victoria herself blessed this colossal menagerie. In New York, Hawkins is commissioned to forge a new tableau for Central Park—Hadrosaurus molded into a reclining sphinx, kangaroo-like Laelaps sparring over a fresh kill. He animates the excavated bones scraped from the sides of mesas, raised like trophies from the canyons and dried sea beds known as the West: a proud display of America's terrible lizards to rival the British. But more terrifying than teeth or sweeping tails as thick as cedar trees is extinction: that the Almighty would allow a species to perish, creation to unhook link by link. And so Tammany Hall shuts the project down, sends thugs under the cover of night to Hawkins' workshop. They sledgehammer concrete legs and smash skulls, wrench apart the frames and bury the remains—fossils never found, still lurking under the Carousel, clawing behind the tunnels of the 8th Avenue subway.

V.

Daughter,

We first reached here three weeks ago, found a camp of River Crows.

They took down their tents, piled furs & skins on their horses and set

children on the piles. Think of tying little 2 or 3 year olds on wild

Indian ponies! Wild sheep are common in the rough banks of the rivers.

We have it boiled, roasted and fried and broiled and it was good.

We see them almost every day when we go out to find in the high rocks

many bones & teeth of reptiles. I have found four new kinds of Laclafis.

They were as large as elephants but their teeth are no larger than the end

of my little finger. One kind had four hundred in its mouth at once.

My Camp is on Dog Creek. We moved there since I wrote Mamma.

The water got so muddy that we had to boil it before we could drink.

Then the high, bare badlands bluffs got slippery as soap so that we could

hardly hunt for fossils, but slid about and got all muddy. Now, farewell.

Read & learn all thee can, for the more thee know the more useful

thee will be. So say thy loving

Papa Edward D. Cope.

Charles R. Knight Paints Marsh and Cope

A thunder-lizard dominates the beach, its tail in the foreground a slithering line Knight pulled across the canvas, its hindquarters voluptuous, the rump of a Ruben nude, thighs and buttocks soft and ballooned. In the distance, two bathing brontosaurs soak their bodies, their necks emerging from the water swaying like the trunks of trees in a strong wind. Knight always observed living animals for a sense of motion: the precision of a bird turning its neck, the agitated stomping of a hoof in the dust. It was he who washed the sky of the Permian in a pastel blue, slumped a sunning Dimetrodon in the sand. It was he who articulated the muscles and flesh, breathed life into the assembled imaginings of Marsh and Cope, like his two fighting Laelaps: one rolled cat-like on its back, all four of its claws raised for battle; the other mid-pounce, a fiendish glaze over its eyes, seeing nothing but its enemy's neck as it drops in for the kill.

VI.

Harlow Reed shakes home from the boneyard under a rib of moon, composing the morning's telegraph to Marsh—*Quarry 4 left to Cope's men. I've taken the liberty to demolish what remained.* In the clear night the Bluff seems to glow from within, as if belts of red clay and purple shale are still wet with sun. By the station house, a horse snorts, looks up from its drink, nostrils silver by starlight, and the hooting of a prairie wolf echoes beyond Robber's Roost—when Coyote uncovered a desert bone he used it to trick the frogs, dug through their dam and sent the world's water to the thirsty crevices of rivers and creeks. Nitroglycerin and diatomaceous earth haunts Reed's hands and clothes. Out here, one hundred miles northwest of Cheyenne, Philadelphia and New Haven are imagined places, less real than Marsh's yarns of primordial jungles and shallow seas that once covered this land—until the Jurassic blackness is broken by a train's whistle and rattle. Before Reed's eyes, in a moving window of light: a woman in a fishtail bustle flips through Henry James by a frosted glass lamp and two men in frock coats deal a hand of cards—one puffs a cigar as the Pullman *Pioneer*, steam-engine dragged, is swallowed again into the prehistoric dark.

VII.

Pet,

Since my last I have got to work in regular style. I am close to my field with a full outfit and everything working nicely. In the meanwhile the cook is getting some bread baked, and I take the opportunity to write to the dear ones who seem to be so far away. I am sitting on a five gallon keg of pickles and my writing is on a box of candles; paper and so on lies on the grass. Last night a chief of the River Sioux, Beaver Head and his squaw, slept in our camp under the wagon, and took breakfast and ate a 'heap Hoggy meat' etc. etc. They behaved with perfect good manners, using their knife, fork and spoon for everything. I showed them your photo at which Beaver Head said 'pretty good' and the squaw suggested that thee cried when I went away. Now farewell. Kiss Julia. I will not get another letter off very soon and a man is waiting to take this down the river.

thy loving husband,

Edward D. Cope.

VIII.

Riding on horseback from Washakie Basin, Cope admires the skull: mountain range of horns along the center of its face, two tusks jabbing downward like a villain's mustache. But it is the grin that inspires the name—the herbivore's once flat teeth rocked by the passage of time into a choppy sea: *crested tooth*, he whispers to himself, *Lefalophodon Cope*. When they arrive at Black Butte, the party breaks up. Sam Smith waves the teamsters to a saloon but Cope heads straight to Western Union—this time Marsh will not preempt his discovery. The name trickles through the telegraph line, the prehistoric rhino stampeding magnetic thunder from Wyoming to Philadelphia. But a slip of the telegrapher's finger adds an extra dot in the Morse Code, an *F* slips into an *X*, and the meaningless term confuses the American Philosophical Society. They enter Cope's description into the record, but the creature will become known as *Tinoceras Marsh*.

IX.

Marsh's pockets bulge with fossilized claws, shoulder blades and serrated beaks lined with teeth. He brushes dust from the relief of a tusk-like canine emerging from the yellow shale of Bridger Basin. *A mammal*, he explains to his students as he fingers crumbs from its nostril—*saber-toothed rhinoceros*. A glint of sunlight from a distant butte betrays a field telescope—Cope's men spying on them for a third straight day. *Perhaps like the rhino who speared the elephant in Sinbad's tale*, Marsh muses, *Cope is blinded by the blood of his superior foe*. By sundown the Yalies break bone from shale bed; it takes three men to heft the massive skull of Dinoceras into a crate. And Marsh sets a trap: leaves the broken jaw from another specimen behind, the teeth of a different animal scattered around it. He smiles and thinks of Cope describing it, instructing Charles Knight to paint this imaginary monster.

X.

Your laughs are reptilian, gentlemen. I know what you whisper about me:
Old Marsh spilled his cranium in a boneyard somewhere between Kansas
and the Late Triassic. What. What? You're here to sit in my wigwam, hold
the cavalry carbine Bill Cody furnished me and smoke from Red Cloud's
peace pipe. Students! All of you the same! Did you know the Sioux
nearly took my scalp? What's excavation to you? Sifting through boxes?
Dusting items in my collection? Never forget: the land, the earth you break
open must always be your teacher. Being a bone sharp is more than digging.
Even Cope understood that much. What do you consider my greatest find?
The Stegosaurus? Triceratops? What. What? Have a look at this tiny fossil.
You see just a tooth. I see it set in a jaw and can see the skull and the vertebrae
sloping into a neck. I see *Hyracotherium vassaccus*, a four-toed horse galloping
across a plain. A horse no bigger than a dog, yet so important. Its discovery
allowed Thomas Huxley to complete his parade of equestrian evolution!

XI.

Papa,

You did not live to see this day: Professor Marsh has succumbed to pneumonia. With only two nurses and a staff member at his side, he died. To his grave he takes his brain, declining to weigh against your 1,545 grams—in this sunset showdown, you stand in the town square alone. You wouldn't like the smell of the Institute these days: thick glass and formaldehyde. Sometimes, they let me hold your skull, and I try to remember what you taught me. For you, bones made the dead inhale, fill their lungs and expel their brittle secrets. Papa! To hear your voice once more—your fantastic stories of enormous sauropods on spongy feet, a second brain buzzing between their hips as they lumber through the fog, their calls a dirge older than any human ear. The men held a service for you at Pine Street: your black-draped coffin a box of bones like those that once cluttered your worktable, the tall *Amphicoelium* femur propped against the wall, your colleagues gathered around you waiting in perfect Quaker silence. The spirit would never move these men of science—sound came only from your terrariums: the scratching of a land tortoise dragging his belly along the bottom of his tank, your Gila monster circling, rising up on her hind legs, pressing her thick-skinned fingers to the glass.

Agony of St. Martin

The Extraordinary History of the Man
with a Lid on his Stomach

In 1822, Alexis St. Martin, a Canadian voyageur, was accidentally shot in the stomach while trading furs on Mackinac Island. An army surgeon, Dr. William Beaumont, was able to save the man's life. He was not, however, able to get the wound to fully close. For the rest of his life, St. Martin had a fistula below his left breast that allowed external access to his stomach. This condition earned him the nickname, "the man with a lid on his stomach." Beaumont used the opportunity to conduct experiments that he documented in his book, *Experiments and Observations on the Gastric Juice and the Physiology of Digestion*. It was a seminal text in the field of gastroenterology.

Come forward! Step through the folds of my tent and behold the old man perched upon a stool. Don't let his dour disposition turn you away. Feast your eyes on the only living gastric fistula in the world! What's a gastric fistula, you ask? Step closer. We'll draw back the curtain and examine: just below the left breast, a cavity pierced straight through as if a Roman Centurion lanced his side. But this is no Biblical humbug, my friend. This is a true miracle of science revealed by the late Dr. Beaumont who pulled this man from certain death, stitched up his torn flesh and in the process stumbled upon wonderment—a gift to the physicians of the world! Observe as the man swallows this grape. You can see the esophagus flex, the muscles of the neck contract and release, and within a moment I press my hand to the wound and... behold! The pure, purple globe emerges again from his side! Indeed, anything this man consumes will pass through him in the very same manner. A gateway to the hidden workings of the stomach itself. A window to prod the mysteries of digestion! See this amazing spectacle while you can. For we are not long for these shores—in six days we sail for England, where the vaunted medical minds of Europe will learn what the self-taught American has revealed. I'm Dr. Bunting and this is Alexis St. Martin, the man with a lid on his stomach. You wish to hear his story? Place a penny in my palm, turn the page.

History, my friend, is a delicate plate—the meat seasoned in the gravy of speculation. Livy tells us Hannibal crossed the Alps, but painters give us constellations of spearheads peppering a blue sky, elephant legs knee-deep in the snow. We know facts: on the morning of June 6th, 1822, a weapon discharged in the store of the American Fur Company on Mackinac Island. And a few conflicting details: Beaumont reports the shot came from a musket, the eyewitness Mr. Hubbard claims a shotgun. Yet, as with so many events that have shaped the course of time, the original cause is forever shrouded. Was fate a sleeve or a leather strap tugging unwittingly at the gun's hammer? Or perhaps the jolt of the shoulder mount striking the floor sparked flint and ignited the dry powder... St. Martin must've felt the breath bottom out of his left lung and smelled the burning fabric of his shirt. The floor slid up behind him and pressed into his back as he found himself staring into the ceiling timbers. After surviving months in the wilderness—canoeing up rivers and across lakes, hefting loads of beaver and fox on his back during portage—here he was, bleeding to death while townspeople gathered and gawked. His ears heard, blanked by the shot, their panicked voices as echoes at the bottom of a well. His eyes fell closed. The voices fell into the chant the voyageurs used to keep time as they paddled. St. Martin clung to that chant, gripped the oar so tight every splinter and knot in the wood seared itself into his palms as he pulled against the river, pulled against the undertow, pulled against the river of cold dark glass.

If you wish to know what happened next, you must sit up with St. Martin that first night among the scent of camphor and the tin of blood. Having extended the man's life for the next few hours, Dr. Beaumont had him moved to Mackinac's hospital. He had done what he could, but he was convinced St. Martin would die. He had seen too many men perish since his first action at the Battle of York, a baptism by bloodbath. Retreating, the British had ignited their fort's magazine—300 pounds of exploding powder shook the earth and smoke blackened the sky. One by one, burning rocks dropped like rain, swelled into a hailstorm of fire and stone, ripped through American uniforms and tore through American flesh. At the hospital, Beaumont waded ankle-deep in blood. Around him, wounded soldiers whimpered like dogs, clenched teeth wormed pain into wood as skulls were drilled through and drained, human arms and legs tossed like firewood into a wheelbarrow. Don't turn away. If you want to hear this story you must understand, as Beaumont did, that our bodies are nothing but thin stems and trunks, our organs jellyfish, voluminous and empty. For thirty-six hours without food or sleep, the doctor slashed and sewed and amputated and trepanned and chopped and bled. The femur of a soldier held down by four friends finally gave under Beaumont's saw—the doctor braced and yanked, the bone cracked. Dizzy with sleep, he handed the loose leg to a nurse, the laces of the boot still tied.

In Dr. Beaumont's garden, St. Martin rested his axe for a moment, caught his breath among the tall white flowers of the horehound, a bine of hops curling clockwise around the fencepost. Even when he does talk about it, his memory of those first few weeks is vague—dreams of being trapped in a burning forest, staring helplessly at cool swaths of Milky Way peeking through cloud-like gaps in the distant canopy above; hearing the disembodied thunder of Beaumont's voice; waking in darkness, body feverish, lathered in the licorice of camphor water. Even a year after his accident, St. Martin remained too weak to resume his life on the rivers. Having been removed from the fort's pauper rolls, he was grateful that Dr. Beaumont took him into his house as hired help, grateful too for Mrs. Beaumont's cooking and her kind words, the soft gurgles of the Beaumonts' baby daughter. Despite the doctor's best efforts, the wound in his side refused to close. Only a plug and a bandage kept him alive, kept food and drink from slipping out of his stomach before it could nourish him. This particular morning, he awoke with tightness in his bowels. Beaumont had him lay down and undid the bandage at his side—his thick fingers parted St. Martin's wound and he inserted a funnel into the aperture, pouring a cathartic directly into the stomach. He gave his patient a sly wink, "As never medicine was before administered to man." Removing the funnel, he patted the wound and reapplied the bandage. St. Martin sat up on the cot, felt the medicine starting to work.

Experiments and Observations on the Gastric Juice and the Physiology of Digestion.
By William Beaumont, M.D. Surgeon in the U.S. Army.

Preface

The present age is prolific of works on physiology; therefore, in offering to the public another book relative to an important branch of **this science**, it will perhaps be necessary to assign **my motives**. They are, first, a wish to comply with the repeated and urgent solicitations of many medical men who have become partially acquainted with the facts and observations it is my intention to detail; men, in whose judgment I place confidence, and who have expressed their conviction of the deep importance of the experiments, the result of which I mean herewith to **submit to the public**: secondly, (and it is that which mainly influences me,) my own firm conviction that medical science will be forwarded by the publication. The reader will perceive some slight seeming discrepancies, which he may find it difficult to reconcile; but he will recollect that **the human machine** is endowed with a vitality which modifies its movements in different states of the system, and probably produces some diversity of effects from the same causes. I submit a **body of facts** which cannot be invalidated. My opinions may be doubted, denied, or approved, according as they conflict or agree with the opinions of each individual **who may read them**; but their worth will be best **determined** by the foundation on which they rest—the incontrovertible facts.

Like a sharp cramp but high in the chest; that's how St. Martin describes the sensation. Beaumont inserted a glass thermometer into the fistula, held it deep and waited for the mercury to rise. Of all the procedures the doctor performed on his stomach, St. Martin found taking its internal temperature to be most painful. But he had agreed to let Beaumont conduct his experiments. He didn't really have a choice. Now a married man, he had financial obligations, children to support. Beaumont withdrew the thermometer, "Debbie is baking a pie for tonight," he spoke while marking the temperature in his notebook—mercury stationary at 99°. "I'd like you to fast for eighteen hours this weekend, so you and the wife should join us for a good meal before." St. Martin buttoned his shirt and watched the doctor wipe the thermometer with a clean handkerchief. Beaumont never called Marie by her name. There had been tension ever since St. Martin arrived with his family in Prairie du Chien (at Beaumont's expense, I might add) earlier that summer. The doctor was preoccupied with the needs of Ft. Crawford's increased regiment during the Indian Council. Thousands of natives made camp along the Mississippi—Chippewa and Ottawa, Potawatomi. St. Martin found himself uncomfortable around the family for whom he once worked. Even Debbie Beaumont's savory cooking was less pleasant accompanied by her hushed remarks about finding it hard to sleep at night, listening to the savages drinking spirits and laughing around their campfires.

XV. August 6th. 8 o'clock, A.M., stomach empty; coats clean and healthy as usual ; secretions less vitiated. Extracted two ounces gastric juice, of more natural and healthy appearance, with the usual gastric acid flavour ; complains of no uneasy sensations, or the slightest symptom of indisposition; says he feels perfectly well, and has a voracious appetite ; but not permitted to indulge it to satiety.—He has been restricted from full, and confined to low diet, and simple, diluent drinks, for the last few days, and has not been allowed to taste of any stimulating liquors, or to indulge in excesses of any kind. Diseased appearances, similar to those mentioned above, have frequently presented themselves, in the course of my experiments and examinations, as the reader will have perceived. They have generally, but not always, succeeded to some appreciable cause. Improper indulgence in eating and drinking, has been the most common precursor of these diseased conditions of the coats of the stomach. The free use of ardent spirits, wine, beer, or any intoxicating liquor, when continued for some days, has invariably produced these morbid changes. Eating voraciously, or to excess ; swallowing food coarsely masticated, or too fast ; the introduction of solid pieces of meat, suspended by cords, into the stomach ; or of muslin bags of aliment, secured in the same way ; almost invariably produce similar effects, if repeated a number of times in close succession.

You take a bite, you chew, you swallow. You know that cucumbers make you belch, that too much spice gives you heartburn. But what do you really know about what takes place in your stomach? Is digestion chemical or mechanical? Or is it a miracle of life, as the vitalists suggest? Does the temperature of the body affect the rate of digestion? Do storms and humidity in the atmosphere affect the rumbling one feels in the gut? This knowledge can be put to practical use, of course. With more soldiers dying of disease and malnutrition than falling in battle, the Army wanted to learn all it could about diet and digestion. But Beaumont saw a larger picture. Truth, like beauty, he would often say, is best unadorned. And here was his chance to grasp it, like a firefly in his hand. A medical doctor, I can understand the importance of this quest. As can you, who can read and probably even write. But St. Martin here had no fancy upbringing. That old, fistulous Alexis (as Beaumont called him) just grumbled and complained, becoming aggravated by the constant experimentation. With increased frequency, meals were spooned, half-digested, from his belly. March 6th: venison, cranberry jelly; March 12th: roast beef, biscuit, and coffee at breakfast; fatty pork, bread, potatoes at supper; March 14th: a pint of milk swallowed for lunch and siphoned from his stomach thirty minutes later; turnips, pancakes, tripe and pig's feet; wild goose, boiled codfish, eggs and parsnips. By the spring of 1831, he demanded Beaumont give him leave to take his family and return to Montreal.

There's a mahogany warmth in the old man's eyes when he recalls that trip home. His family piled into a birch bark canoe—Henriette, just a baby, swaddled in Marie's arms, Charles and Alexis Jr. peering into the swiftly moving water, imagining mermaids with red hair blooming soft clouds around elf-like faces—his arms pulling the Mississippi, sweeping them away from Prairie du Chien and towards home. This is how St. Martin remembers the world: voyageurs arriving at a trading post in canoes laden with blankets and muskets, tobacco and kettles, native hunters emerging like pale ghosts from the foliage, the elaborate smoking rituals that preceded any trade, the clerks converting fox fur, buffalo and wolf pelt into the currency of made beaver, the hunters selecting their treasures (yards of cloth, pounds of gunpowder and bags of shot, playing cards and gallons of high wines) disappearing into the night. Landing on shore after a day of travel, St. Martin taught his sons how to smoke tobacco from a Menominee pipe, how to trap a beaver and how to prepare the pelt to Hudson Bay Company standard. They would sleep under the overturned canoe, one side propped up like a tent and in the mornings he would teach them to inspect the birch-rind bottom and how to gum the leaks.

Experiment 49.

Having procured some fresh gall, from an Ox recently slaughtered, I added twenty drops of it to four drachms of the chyme formed in Experiment 26, (Jan. 11th, 1830.) A turbid, yellowish white fluid, or rather, very fine, cream-coloured coagulæ, immediately formed ; which, after standing a few minutes, separated into bright, yellow coloured coagulæ, subsiding towards the bottom, and a turbid, milk coloured liquid above. By adding twenty drops more of the bile to this, the coagulæ were increased, more collected together, and changed in colour, from a yellow to a greenish hue. The addition of twenty drops more of bile, (making, in the whole, one drachm,) concentrated a deep grass green, jelly-like deposition at the bottom of the vial. The fluid above, became more milky in appearance; and the coagulæ and sediment became darker on the addition of bile. I now added twenty drops of the dilute muriatic acid to other four drachms of the same kind of chyme, without bile. This produced no change in the colour or consistence, but increased the saline, acid taste, peculiar to the gastric and pancreatic juices, when uncombined with chyme.

By now I'm sure you understand that experimentation requires a touch of viciousness. Do you know Lazzaro Spallanzani and his room full of bats? Some had their eyes burned out, the orbits filled with wax; others had varnish covering their bodies, others their ears sealed tight, others had musk-dipped sponges plugged into their nostrils, others their tongues cut out. When the bats that couldn't hear bumped into walls, fluttered in the chandelier, he discovered that they navigated by sound. This was Beaumont's hero. "Spallanzani also investigated the stomach," he told St. Martin. It was Christmas Day, 1832 and they were walking along Lake Champlain. St. Martin had reunited with Beaumont in Plattsburg that October. The doctor related how Spallanzani experimented on himself by swallowing bits of beef tied to a string and drawing them back out through his throat to note the condition of the meat. Earlier that morning, after a breakfast of fatty pork, corn bread and coffee, Beaumont had taken the temperature of St. Martin's stomach twice and examined the state of the food within. St. Martin still felt the cramp as they took their walk and Beaumont waxed on about the heroic scientist: "He even swallowed tiny vials of sponge to extract the gastric juice. The metal scraped his esophagus as he fished it back up through his throat, gagging and spitting blood." Beaumont paused. "He was experimenter as well as subject, good Alexis—a better man than us both."

Experiment 95.

Feb.3. At 12 o'clock, M., I put two equal and entire pieces of parsnip, ten grains each, one boiled, and the other raw ; the same kinds and quantities of carrot ; and the same of potato—into four drachms of gastric juice, and placed them on the bath. At 12 o'clock, M., on the 4th, the vegetables taken out and wiped or filtered as dry as when put in, shewed the following result: The piece of **raw parsnip**, weighed three grains ; the boiled, one grain. Raw carrot, three and one fourth grains ; boiled, half a grain. Raw potato, eight and a half grains ; boiled, no entire particle could be distinguished—a fibrous and farinaceous residuum of six grains remained on the filter. At 12 o'clock, M., on the 5th, the pieces of parsnip and carrot were almost entirely dissolved, a grain or two of the raw **carrot**, and fibrous centre of the parsnip, only **remaining**. About a grain of the roughish white farina of the **boiled potato**, remained. The raw potato was a little **softened** and wasted on the surface, but weighed the same as at last examination, eight and a half grains. This is an illustration of **the necessity of tenderness and susceptibility of division** of the articles of diet, for speedy solution by the gastric juice. The raw potato retained nearly its weight, after the other articles were dissolved.

Come closer. This is a story I must whisper, for if St. Martin hears it retold, his lip thickens and his eyes grow wet. It was summer, 1833. Word had just arrived that little Henriette was dead. St. Martin spent his free time alone in the woods, taking refuge in his cups. The harvest of his farm outside Montreal ached inside him—Marie sitting alone in their tiny kitchen, steamed fruit pudding simmering on the iron stove, a muskmelon ripening on the windowsill as a summer breeze tousles the blue knit curtains. After two rations of whiskey, these thoughts became palpable. He could hold Marie's face in his hands, brush a lock of hair from her eyes. I must speak even softer now; St. Martin hears us, his face flushing red. Stumbling through those woods, he could even see Henriette, playing hide-and-seek in the trees, a purple smear of fruit across her laughing mouth. He knelt down, called out to her. She refused his embrace, but with child-sized palms scooped whole whortleberries into his mouth. He closed his eyes, felt the juice run down his chin, felt the pressure of her delicate fingertips resting on his lips.

V. July 13. 5 o'clock, 30 mins., A.M. Weather clear serene, and calm. Thermometer 69°. Stomach empty, healthy and clean. Temperature 99 1-2°, before rising from his bed. 6 o'clock, 30 mins. Weather same as at last examination. Stomach empty. Temperature 100 3-4°, after rising and walking out in open air, twenty or thirty minutes. 6 o'clock, 45 mins. Returned from a smart walk, exercising so as to produce gentle perspiration. Temperature 101 3-4°. VI. July 14. 5 o'clock, 30 mins., A.M. Weather variable—heavy thunder shower, during the night. Wind S., moderate. Th: 75°. Stomach empty.—Temperature 100° on rising from bed—100 3-4° after walking out into the open air, and immediately back. 9 o'clock, P.M. Weather rainy—atmosphere oppressive. Th: 79°. Wind S., light. Temperature of stomach 102°. St. Martin has been in the woods all day, picking whortleberries, and has eaten no other food since 7 o'clock in the morning, till 8 at evening. Stomach full of berries and chymifying aliment, frothing and foaming like fermenting beer or cider—appears to have been drinking liquor too freely.

I found St. Martin wearing rags and walking barefoot through his fields, dramming and pulling up weeds. He offered me his flask and told me about the night he picked up drinking again: standing in the kitchen, pouring from a jug of forty-rod after Marie and the children were asleep. A letter with Beaumont's signet lay open on the table in a gas lamp's ring of light. Earlier that day, with the priest's help, he was able to make out the contents. For sixteen years, St. Martin had been absent without leave, a deserter from the Army and from his duties as the doctor's covenant servant. He swallowed hard, welcomed the burn in his throat and looked out the open window, inhaling the vegetable dark. In his arms, he felt the ache of the day's planting. Marie had convinced him to remain here, that he could support their family tilling the land. Beaumont wanted to take him to Paris where learned men would prod his wound, scratch observations in their notebooks. He would have been unable to read their words, but could've told his jokes that are only funny in French. He poured another and looked at the letter again, heard Beaumont's words in the priest's voice: *Come therefore and enjoy the blessings reserved for you and oblige your old friend & benefactor.* It was too late now; he had stopped replying to Beaumont's petitions years ago. Whole days passed where he even forgot about the hole in his side, how close he had been to death. He caught a touch of manure on the night air and his thoughts drifted back to the land, how four inches down, even in May, the earth remained hard, could break the sharpest plough. He was just a farmer now.

Last month we stopped in St. Louis, where St. Martin insisted that we visit the home of Mrs. Deborah Beaumont. The old woman instantly recognized him as we approached the porch of her home. She embraced St. Martin, called him *Dear Alexis* and kissed him on both cheeks. She brought out chairs and served us iced tea and thick slices of watermelon glazed with honey and lime zest. They talked so long, I watched the summer sky go dark and slapped mosquitoes off my arms. They reminisced about Ft. Mackinac: the endless, ice-locked winters broken only by feasting at Christmas; how they would spend evenings reading Shakespeare aloud; how Dr. Beaumont's poppies erupted in the garden every spring and how the horehound curled its way around the oak. She made no fuss over my research, or the fact that I hope to republish her husband's famous work alongside my own. St. Martin, in turn, asked after the children: especially Israel and Sarah, the small baby born two days after he was shot, now grown into a sad woman whose husband had fallen during the Mexican War. And his jaw stiffened, and I dare say he even put his hand to his wound, when Debby related Dr. Beaumont's accident on the icy steps, and his death a few months later.

Experiment 104.

Feb. 14. At 9 o'clock, A.M., I took forty grains masticated, broiled beef steak, divided into two equal parts—put one into four drachms gastric juice, and the other, into four drachms of a mixture of dilute **muriatic** and acetic acids, reduced with water to the flavor of the gastric fluid, as nearly as practicable—three parts of the **muriatic** to one part of the acetic. Placed them together on the bath. At 6 o'clock, P.M., the meat in the gastric juice was all dissolved; that in the dilute acids, when filtered, left a **residuum** of nine grains, of a jelly-like consistence. The fluids, also, differed in appearance. That from the gastric juice was opaque, and of a lightish grey colour, depositing a brown sediment on standing. The other was also opaque, and of a reddish brown colour, but deposited no sediment. This was an attempt to imitate the gastric juice. It was not satisfactory. Probably the gastric juice contains some principles **inappreciable to the senses**, or to chemical tests, besides the alkaline substances already discovered in it.

It's time to say goodnight to St. Martin. Not to fear, he still has many years ahead of him. He will survive to the age of 86, if you can believe it—longer than you and I, perhaps. And they will be healthy years too. Some report seeing St. Martin standing in a field chopping wood two days before his death. It will be an ordeal, putting this man to rest. The United States Army will demand an autopsy and attempt to procure the stomach for preservation in a museum. But friends and family decide that his service is over. They will leave his body in the heat for four days, the decay so rank that his corpse must be kept outside the church during the funeral mass. Local doctors will tap out a telegram to the army: "Don't come for autopsy; will be killed." The gravediggers will bury his coffin eight feet under and cover it with slabs of granite. Armed villagers with rifles will stand guard at night, defending against resurrection. Eventually, his unmarked grave will be forgotten, his body decomposed into charts and experimental data. But that will be over twenty years from now! Tonight, St. Martin is safely asleep and we must draw the curtain, close the tent. But perhaps I could interest you in a vial of gastric juice? Two drops in a glass of soda water will relieve indigestion. Or if you return tomorrow morning, a photographer will be here. For a dime, you can have a tintype of yourself standing with St. Martin, your finger resting gently in his wound.

Grant's Dissector

1. Back

The spinal cord is not in uniform diameter down its length. Retract the arachnoid mater and observe. A vertebral column forms the axis of the body. There are many deep muscles of the back.

On her erector
spinae, butterflies open their multi-
colored wings—pale green and yellow;
delicate pastels etched onto honey
skin. Without membrane motion, *perhaps*
Rome never rises on its seven hills.
Perhaps Europe is forever a dark forest.
They flutter, then rest. The curved
edge of a flimsy wingtip slips
into the ridge of her median furrow.

2. *Upper Limb*

Adapted into a body part of great freedom.
 Function to place the hand as
 a grasping tool. The four muscles arising
 from the dorsal surface of the scapula
 will be dissected, and their nerves and blood
 vessels will be demonstrated. In the living
 body, the superficial veins may be conspicuous
 through the skin. The order of dissection
 will be as follows:

High school basketball,
 shirts vs. skins maneuvering for position
 on the gymnasium floor. Gripping
 the rubber gooseflesh ball between fingers
 spread wide, I bend my knees to take a shot—
 on my sweating chest, the plastic-wrapped
 square of my scapular sticks to my skin,
 a brown postage stamp to deliver my soul
 directly into the Virgin's arms, trusting
 in resurrection: that the miracle of flowing
 blood, electric impulses twitching the muscles
 of fingers, the turn of a wrist can happen
 yet again—nothing but
 backboard and the shirts recover the ball.

3. *Thorax*

Surface anatomy can be studied on living subject or cadaver. Protective function of the thoracic wall combined with mobility to accommodate volume changes during respiration. Alternating arrangement of ribs and intercostal muscles. The heart will be detached from the great vessels.

We protect what we value—certificates of birth, passports locked away in the strongbox stashed under the floorboards; a cupboard with a glass door so the fancy china can be admired; slipcovers and jackets over the Beatles vinyl; Pop's tattered flag from World War II in a special frame, shielded from ultraviolet light; Mylar sleeve for *Spider-Man* #5. The heart sleeps behind the smell of a bone saw burning through ribs, tucked behind the lungs, the pericardium a fat velvet bag.

4. Abdomen

Divided from the thoracic cavity
by the diaphragm. The liver comprises
2.5% of an adult's body weight. Kidneys
are well protected by their position
and a layer of fat. Viscera contained
within the cavity are not bilaterally
symmetrical.

We now assume it was
Shelley's liver, not his heart, they brought
to Mary in a wooden box—in lab, abdomens
are cloverleafed open, greater omentum
spilling like leaves, the edges of intestines
browned petals; a liver removed
with latex gloves, a liver picked
from a pyre's charred twigs—she broke
at its generous size but couldn't know the liver
is the last organ of the body to burn.

5. *Pelvis and Perineum*

The pelvic cavity is continuous with the abdominal cavity, transition occurring at the plane of the pelvic inlet. The pelvic cavity contains the rectum, the urinary bladder, and internal genitalia. Structures in the anal triangle are common to both sexes.

She ached for this, fingers in Byron's hair, his teeth surrendering at last to the urge she knew her hips could inspire. She remembers Mary's stories of the dissection room as her own body becomes his object—no Voltaic pile needed to tingle her muscles to life. She remembers seeing sketches of Susini's *Medical Venus*, hair flowing down the figure's wax body, drowsy eyes open, heart and kidneys exposed, a fetus curled in the circle of her womb. Claire shudders and feels him beached in her pelvic inlet, sea foam and sand crusted along his limbs.

6. *Lower Limb*

Functional requirements are weight bearing, locomotion and maintenance of equilibrium. As such, it is constructed for strength at the cost of mobility.

The lower limb is divided into four parts. It is worth noting the term *leg* refers only to the portion between knee and ankle.

A fracture spiraled staircase-like around my tibia, kept me on the first-floor library that bitter winter of freshman year. The Friars provided reading assignments in lieu of class. I became absorbed in Judges, how Samson on the road to Timnah ripped open a lion with his hands. Ken shot for the yearbook, shared his pictures from homecoming, the bookish Dolores sitting in a knee-length skirt at the end of a bench of cheerleaders; we both lamented he cut off her legs just at the ankle. Returning later to Timnah, Samson discovered the lion's carcass splayed open, fragrant with bees and honey.

7. Head and Neck

Packed with structures associated with proximal ends of cranial nerves and organs of special sense. The skull is an important tool to organize study. Infoldings must be cut to remove the brain. Trace the route of a drop of blood from the great cerebral vein to the internal jugular vein. The bones of the orbit form a four-sided pyramid. The medial wall is very easily broken. Never hold a skull by placing your fingers into the orbits.

First lab after daylight savings time and the sun slices deeply into the room. After eight weeks, faces emerge like apparitions through tightly wrapped gauze—nose defined, hints of eyelids, of lips. In high school psychology, Fr. Robert brought a thick jar into class, human brain blooming inside. In paintings, a hand on a skull tells us the figure is contemplating death. That the mind fails to recognize itself suggests we really are ghosts haunting this unfamiliar machine—the body protecting its own secrets. It is dark before lab is over, clinical fluorescents glossing windows into mirrors and we can see ourselves slicing into ourselves.

An Art to be Learned

The Spyglass Discovers Hans Lippershey (1608)

In the spectacle-maker's shop, the spectacle-maker
observes his children toying with glass—his daughter
bends a scrap of light across the slack floor,
unnerves the marbled tabby while his son
imagines a glass amulet through which he can
scurry unfolding futures—and is moved to invention
when

the lens and the lens and the eye

swing like planets into alignment—arranged
to string light taut—a distant steeple magnified:
louver shutters exposed to their wooden grain,
even feathers sharpen, bas-relief on the curved
copper breast of the rooster weathervane.

Uranus Triptych

William and Caroline Herschel Catalogue the Heavens

They documented everything they found: impact
craters, comets too distant for tails; they unveiled
double stars where most saw only one and measured the parallax

between them. Their brother Dietrich had an eye for detail,
a box of butterflies—*Colias* and *Cynthia*, *Caligos*
with owl eyes peering from their frail

hind wings, each specimen chosen
to represent its species. Caroline longed for a box: linen-
lined interior where her discoveries could be held, rows of

thin
steel
pins

around which gaseous nebulae could congeal—
intangible stars set like pearls; galaxies
churning around tiny axes like petals on a stem, like luminescent pinwheels.

Herschel's Measures

Some of our astronomers here incline to the opinion that it is a
planet and not a comet; if you are of the opinion it should
forthwith be provided with a name or our nimble neighbors, the
French, will certainly save us the trouble of Baptizing it.
—Joseph Banks to Herschel

Like the blond heads of choirboys under the Cathedral's dome, the night sky
holds a loft of stars. William Herschel tunes his reflector to the symphony,
ancient light a soft legato around him. Night after night, he quantifies

each note and fixes it on the staff. It is all mathematics: the frequency
of an E-flat, the timbre of a warm yellow sun, starlight threading the aperture
of a telescope's eyepiece, the modulation between major and minor key.

In the garden behind his house at Bath, Herschel takes an orbit's curvature:
Out of tune with celestial harmonics, this object
doesn't blur into the fuzzy swab of a nebula, but maintains a pure

disk, a whole note swimming in retrograde motion. Perhaps a comet?
Or something unthinkable. A discovery that would crack the disguise
of a six-planet universe: an invisible world revealed through measurement.

William Herschel Entertains the Princesses

The effect was fine and so natural that the best
 astronomer might have been deceived. Their
 Royal Highnesses and other ladies seemed to be
 much pleased with the artifice.
 —William to Caroline, July 3, 1782

The cloudy night spurned
 the Royals' stargazing hopes,
 so Herschel hung a lantern

crafted to replicate the glow
 of Saturn and its ring formation
 when viewed with a telescope's

lens. With this creation,
 they could all feel the pure
 pleasure of observation.

Herschel was forty-four
 and still unmarried,
 pleased to be at court

with princesses & ladies
 orbiting on his arm,
 captured by his stories:

long nights in his garden,
 he and his sister Caroline
 cataloging not just stars

but every object that shines:
 comets and planets,
 scattered gases of nebulae;

or how Galileo professed
 people on Jupiter: for why
 would God have set

moons spinning in the sky
 unable to be discerned
 with the unaided eye?

Vavilov's Harvest

As part of Stalin's Five-Year Plan, collective farms were established to meet the food demands of Soviet Russia's growing industrial cities. In the rush to increase the yield of these farms, Stalin designed his policy around the inflated promises of a pseudoscience known as vernalization. A theory supported by the agronomist Lysenko, the theory of vernalization was based in Lamarckian genetics and claimed to be able to change the nature of a plant by exposing the seed to different temperatures before germination. It was seen as a superior alternative to Western science. Legitimate scientists who argued and fought against this policy were removed from their positions, imprisoned, exiled and sometimes killed. Nikolay Vavilov, one of the premiere botanists and geneticists of the twentieth century, was among the victims. Russian science was set back more than a generation and, when the agricultural policy resulted in massive crop failure, millions of people starved.

Vavilov Discovers Lysenko (1925)

He seems made of earth, mud caked under
 his nails, in the wrinkles of his face, his blue
 eyes scanning the experiment station's
 rows of plants, whispering as he upturns
 leaves and uncurls tendrils, checks the firmness
 of each stem, each flower's bloom.
 Shoeless, raised from peasant stock, this Lysenko
 has amazed the nation with his peas:
 legumes miraculously blossoming
 at northern latitudes! In this man, Vavilov perceives
 poetry at work—the embodiment of a metaphor
 the state requires to
 galvanize science: untrained at university,
 he never studied *the hairy legs of flies*. Stern,
 improvising, creative. This one, at least,
 wields a discerning
 mind. Perhaps with fostering, Vavilov thinks,
 science is a discipline he can learn.

Arrested in the Carpathian Mountains (1940)

We shall go to the pyre, we shall burn, but
we shall not retreat from our convictions.
—Vavilov, 1939

Sunlight flares the tips of tall grasses bending
in the wind, spikelets of wheat glow—

gradient fluctuations of emmer and spelt—as Vavilov
wades out to where the slopes and the sky

collide, waist-deep in *Triticum*, a wheat cultivated in the Balkans millennia ago. He feels a reverent

delight towards this mystery: a primitive species thriving far from home. This expedition, he knows,

incited Lysenko's anger, another refusal
of State science, taking sides with those

opposed to vernalization. So when a black Ford,
Soviet-built, lumbers up the mountain's tight

road, Vavilov recalls the scriptures his mother
read to him as a child: Christ

obedient in the Garden before his arrest. Never
a praying man, Vavilov scans the mountainside:

bright amber shimmering beyond his eyes,
a harvest he leaves unknown.

Interrogation (1940)

“Who are you?”

“I am Academician Vavilov.”

“You are a bag of shit and not an Academician.”

—NKVD Case File No. 1,500

Backlit silhouette, a faceless inquisitor, gunmetal
chair legs scraping the floor, no clock,

air webbed in smoke, strands curling
metallic under the tongue. “Don’t play

innocent. Your crimes are well documented, re-
constructed. Do you think that we’re not

aware of your wrecking activities?
Disrupting crop rotation? Betraying

Soviet institutions, our Plant Breeding program?
There’s even evidence of you, supposed patriot,

plotting with foreign agencies. Espionage, Professor!
Yes? You understand the punishment?”

Khvat grins, lets time gather behind cinderblocked
windows, snubs out his cigarette in a tin

tray, ash mountains shifting with fluffed
tectonics, the drift and drag of a chair.

Death at Saratov (1943)

Prone on this packed sod floor, the prisoner
is consumed by his own body, cheek
bones jagged under his eyes. Vavilov feels
his strength ebbing like a dried creek,
numbers the mahogany tendrils of veins
rivering into the reed of his wrist—
diminishing—cell by cell, cytoplasm evaporates,
mitochondria and un-ribboned reticulum
beach like seaweed on shivering translucent
membrane shores—brittle fibers decomposed.

Search for Planet X

By the end of his life, Percival Lowell's reputation as an astronomer was in ruins. He had incorrectly claimed that there were canal-building civilizations on Mars and had spent his last years failing to prove the existence of a trans-Neptunian planet. When he died in November of 1916, the search for his Planet X came to a halt. Thirteen years later, the Lowell Observatory in Flagstaff, Arizona resumed the search for this planet. They purchased a new telescope specifically for this purpose and hired Clyde Tombaugh, a young amateur astronomer from the Midwest, to continue the quest that Percival Lowell left incomplete.

Figuration

A spell of rain means no farming to be done. In the stable temperature of the basement cave, among the milk and eggs, last year's tomatoes canned on a shelf, Clyde Tombaugh crafts a primary mirror. He's done with the polishing—the melted pitch of abrasives, fatigue burning his shoulders and arms, rumbling growl of the grinding tool plowing its orbits as the repeated motion carves a concave curve into the glass—and turns his attention to the figuring laps: short strokes evoking a W at the disk's center. Rotate and repeat. The perfect paraboloid will bring optimal performance: twelve thousand year old starlight from Cassiopeiae Rho cupped in a mirror's palm, a yellow giant shaped into focus on the film of a human retina.

Retrieving Clyde Tombaugh from Flagstaff Station

Dr. Slipher cranks the Model T to life, listens as a universe churns under the hood—starter-shaft turns and sparkplugs pop; petroleum sizzles with charge and combusts, rattling pistons and spinning the sun axis, rotation and torque churning the planetary gears. The sky too is a giant machine, demands logic and methodology from those who would observe it. V.M. Slipher checks his watch; the train with their new astronomer will soon arrive, and he wonders what gear set Clyde Tombaugh in motion. Unsolicited, the young astronomer's portfolio arrived one day in a pile of mail—Slipher unrolled the graphite sketches from their tube: sheets of draft paper adorned with the gorgeous curves of distant worlds, their mare and mons, Jupiter's storms poured like cream into coffee—weather systems under a perfect surface blooming.

Nightshift at Flagstaff Observatory

At the telescope, eyes differ surprisingly little,
brains surprisingly much.
—Percival Lowell

Under the observatory dome, Clyde Tombaugh sets the photographic plate like a trap—a glass slab bathed in an emulsion of silver salts that will absorb the faintest of stars. He must do this in the dark, thumbscrews fixing the plate into the 13-inch telescope, and he recalls Dr. Slipher's stories about Nicholas Saunderson, the blind mathematician who lectured at Cambridge on optics. It was said he could distinguish counterfeited coins by fingertip, hear the size of the dining hall in the echo of a dropped cup. Tombaugh opens the scope's aperture and waits while focused starlight shakes silver atoms from their grains of bromide and chloride—when the chemicals are washed away, the night will be a latent image holding more stars than any Kansas sky. Alone under the dome, Tombaugh remembers those dark mornings on the prairie: sitting among the crickets and intoxicating waves of switch grass, a homemade telescope forged from car parts and broken farm machinery pointed at the universe swarming above him like a head-full of bees.

Speculation

When Dr. Slipher first arrived at Flagstaff, the search for Planet X had already begun. Percival Lowell would position two clear plates over each other, slightly offset, and examine each star for retrograde motion with a handheld glass. He was always found guilty of wanting more than observation could give: Martians that could teach us to live in peace, an undiscovered planet to solve the solar system's messy math. Slipher remembers how Lowell's depression grew as the telegraphs from Europe reported trenches, gasmasks, casualties at Verdun—none of his hopes had ever come to pass. Those days at the observatory, Venus the cow lowed under the ponderosa pines, and Lowell died convinced a ninth planet existed: watery nugget of yellow-gold in a deep black stream.

Blinking at Planet X

Behind the blink comparator, twin bulbs glow and cast rust orange globes on two photographic plates where stars lie splattered like black paint across the glass, endless spots blemishing a sun's perfect face. Tombaugh peers into the eyepiece, examines a square of sky and clicks between January nights. Even with this new technology, he will know his planet just as the ancients knew theirs: a wandering star drifting backward against the celestial sphere. He clicks between nights while the ticking of the sidereal clock slowly overtakes the ticking of the solar. After seven thousand hours, three hundred thirty-eight plates to check ninety million stars, he has grown comfortable in dual times, clicking between nights. The black specks tremble from plate to plate until one disappears on the 23rd, reappears in a retrograde position on the 29th. Tombaugh notes the time is four o'clock, strolls down the hallway and taps the office door, "Dr. Slipher, I have found your Planet X."

Discovery

Clyde took the Model-T into town, collected the observatory's mail, ate alone at a diner, and walked Aspen Street while looking up at the cloudy sky he was anxious to re-photograph. Snow frosted the streetlamps and storefronts, and couples stood in line at the Orpheum, and when the night still refused to clear, Tombaugh joined them, filed into the theatre and watched Gary Cooper in *The Virginian*. If you discovered a world, what would you do? Clyde Tombaugh drove back up to Mars Hill, stood in the cold by Lowell's mausoleum and stared into the scrap of sky where the new planet remained veiled: he had lived to see the universe change. Back in the office, he sorted the mail, fed the furnace for the night, brushed his teeth and flipped through the glossy pages of an outdated astronomy magazine.

Calculation and Recalculation

I.

Something human pushes us to solve for X, to cross darkness with imaginary lines, to map the earth from a horizon's bend, to watch the moon fall and rise and fall again, to name that motion orbit. We learn to see one thing by observing another: illness in the dog's uneaten bowl of kibble, or how Dr. Slipper saw the universe expanding in the red shift of a nebula's glow. By Percival Lowell's calculations, Neptune alone could not account for the residuals of Uranus' orbit:

ϖ = [perihelion] A planet's closest approach to the sun.
 n = [mean motion] The speed of an elliptical orbit.
 i = [inclination] A slight tilt from the orbital plane.

Swirling the remaining [mass] like brandy in a snifter's glass globe, Lowell poured it into a single point:

m = Planet X.
 Invented to balance the equation.

II.

Voyager 2 approached Neptune in 1989, and by the pull of its gravity measured the precise mass of its distant methane seas. Two planets held in balance.

When the equation is finally solved,
 X vanishes.

Demotion

Pluto is a "dwarf planet" by the above definition and is recognized as the prototype of a new category of Trans-Neptunian Objects.
—Resolution 5A, International Astronomical Union, 2006

Just a nail on the planetarium wall where a ninth planet once brought up the rear. Like the sad circus clown wobbling behind the parade of massive elephants with a shovel in his hand, Pluto captured the sympathy and delight of children and those who pull for the underdog. A sentimental public revolts as textbooks are rewritten and diagrams amended. Online petitions accumulate signatures, the State Legislature declares that Pluto will always be a planet in the sky of New Mexico, and a hip-hop artist laments, *Eight planets bullied number nine until he fell*. But as the eighth and last float passes by, the lone fez cap over the horizon is joined by others, a swarm of Shriners honking horns, gleefully buzzing around some unseen point in their tiny cars.

Ascension: 2015

Interred herein are remains of American Clyde W. Tombaugh,
discoverer of Pluto and the solar system's 'third zone'...
—Inscription on the New Horizons Spacecraft, launched 2006

The god of the underworld waits in the sky: frozen prairies of nitrogen,
methane snow swirling brown in starlight. Like Charon, Tombaugh will bend
into synchronous orbit and rotation, always facing the object of his devotion

before crossing beyond its pull... but not into nothingness, across an untread
wilderness where the sun is but a faded flare and gravity is the lure
of gods and goddesses exhaling into the dark, their perfumed bodies spread

across the night—Eris and her daughter Dysnomia; flat and featureless Orcus;
ice-speckled Varuna; and soft Haumea, spooned into an egg by her rapid spin—
tumbling through a Kupier sea its cold waves washing the sands of hidden shores.

NOTES

Bone Wars

- Pg. 3: This event took place in 1869 and is seen by many to be the opening “shot” of the Bone Wars. The italicized text is taken from an article written by Marsh and published in the *New York Herald* twenty years later.
- Pg. 5: This poem was composed by adapting the original text of a letter Cope wrote to his wife, Annie. While the language is Cope’s, I’ve removed large sections of the text, pairing it down to the details that seemed most evocative. The letter, dated July 17th, 1892, is included in Osborn’s *Cope: Master Naturalist* (429).
- Pg. 6: This event was chronicled by Charles Betts in “The Yale Expedition of 1870” published in Harper’s New Monthly Magazine, October 1871.
- Pg. 7: Benjamin Waterhouse Hawkins’ Central Park workshop was destroyed in 1871. There are at least two different locations speculated for where his dinosaurs may be buried. They have never been found.
- Pg. 8: Another poem composed by compressing the text of a letter from Cope. This one was addressed to his daughter, Julia. Dated September 17th, 1876, it too is included in Osborn’s *Cope: Master Naturalist* (227).
- Pg. 9: An ekphrastic poem inspired by several of Knight’s paintings in the Field Museum in Chicago including *Brontosaurus* and *Reptiles of the Permian Period* (1930).
- Pg. 10: This event took place at Como Bluff in 1879. The italicized text is taken from a letter Reed wrote to Marsh. It is unclear the degree to which Marsh directly ordered the destruction of fossils or if the action was something his men took upon themselves.
- Pg. 11: Another poem composed by adapting the text of a letter written by Cope. This one was to his wife, Annie, and is dated August 27th, 1876. It too is included in Osborn (223).
- Pg. 13: This event most likely took place in August of 1872. The exact species of the remains that Marsh’s men mixed together is not documented, but Cope’s naming of the invented creature and discovering years later that he was fooled is.
- Pg. 14: A persona poem. Though no longer actively teaching at Yale, Marsh was known to entertain students at his home in the years before his death.

Pg. 15: An imagined letter written by Julia to Cope after his death. Details of the Pine Street service were taken from Osborn's biography. William Collins, Julia's husband, was present at the service.

Agony of St. Martin

The material used for the experiment sections on pages 22, 24, 27, 29, 31 and 34 is taken from William Beaumont's *Experiments and Observations on the Gastric Juice*, the original manuscript that documented his experiments on Alexis St. Martin.

Grant's Dissector

The first stanza of each section is adapted from the text of *Grant's Dissector*, 13th Edition by Patrick W. Tank.

Pg. 37: The italicized text is quoted from "A Sound of Thunder" by Ray Bradbury.

An Art to be Learned

Pg. 45: This is one (apocryphal) version of how the spyglass was invented. Two other spectacle makers, Zacharias Janssen and Jacob Metius, are also sometimes credited with the invention.

Pg. 46: William Herschel was making his living as a professional musician in Bath when he became interested in astronomy. Although an amateur astronomer, he built the most powerful telescopes of his day and, along with his sister Caroline, catalogued hundreds of nebulae and comets. His original name for Uranus was "Georgium Sidus" (the Georgian Star) after King George III.

Pg. 49: This series of poems features an invented form: the "double-helix" poem. Each poem contains four rhyming sounds. Two sets of two rhymes are paired together by being on opposite margins, at the beginning and the end of each line, similar to the way amino acids are paired together in a strand of DNA.

Pg. 50: Vavilov was one of the first scientists to suggest that there were "hotspots" or centers of biodiversity where all cultivated crops developed. One of the ways in which Vavilov tracked down where these crops originated was through language. As Gary Paul Nabhan explains in *Where Our Food Comes From*, "The mere act of naming a newly found variant of onion or apple leads to its isolation and further selection if the novel plant is given special care by an observant farmer. Vavilov somehow surmised that at a larger scale... linguistic diversity could well have fostered crop diversity."

Pg. 51: Italicized text taken from Soyfer's translation of the article, "The Winter Fields" by Vitaly Fyodorovich which appeared in the Soviet journal *Pravda*. The study of fruit flies was emblematic in the Soviet press for how bourgeois scientists "wasted time."

BIBLIOGRAPHY

- Beaumont, W.: Experiments and Observations on the Gastric Juice and the Physiology of Digestion (facsimile of the original 1833 edition). New York, Peter Smith, 1941.
- Bensley, E.H.: Alexis St. Martin and Dr. Bunting. Bulletin of the History of Medicine 44.2: 99-108, 1970.
- Betts, C.: The Yale Expedition of 1870. Harper's New Monthly Magazine Oct. 1871.
- Davidson, J.P.: The Bone Sharp: The Life of Edward Drinker Cope. Philadelphia, The Academy of Natural Sciences of Philadelphia, 1997.
- Horsman, R.: Frontier Doctor: William Beaumont, America's First Great Medical Scientist. Columbia, Missouri, University of Missouri Press, 1996.
- Jaffe, M.: The Gilded Dinosaur: The Fossil War Between E.D. Cope and O.C. Marsh and the Rise of American Science. New York, Three Rivers Press, 2000.
- Joravsky, D.: The Lysenko affair. Chicago, University of Chicago Press, 1986.
- Lemonick, M.D.: The Georgian Star: How William and Caroline Herschel Revolutionized Our Understanding of the Cosmos. New York, W.W. Norton & Company, 2009.
- Lowell, A.L.: Biography of Percival Lowell. New York, Macmillan Company, 1935.
- Nabhan, G.P.: Where Our Food Comes From: Retracing Nikolay Vavilov's Quest to End Famine. Washington, Shearwater Books, 2009.
- Osborn, H.F.: Cope: Master Naturalist: Life and Letters of Edward Drinker Cope. Princeton, Princeton University Press, 1931.
- Ostrom, J.H.: Marsh's dinosaurs; the collections from Como Bluff. New Haven, Yale University Press, 1966.
- Parsons, K.M.: The Great Dinosaur Controversy: A Guide to the Debates. Santa Barbara, ABC-CLIO, Inc., 2004.

- Popovsky, M.: The Vavilov Affair. Hamden, Connecticut, Archon Books, 1984.
- Soyfer, V.N.: Lysenko and the tragedy of Soviet science. Trans. Leo Gruliow and Rebecca Gruliow. New Brunswick, NJ, Rutgers University Press, 1994.
- Tank, P.W.: Grant's Dissector. 13th ed. Philadelphia, Wolters Kluwer/Lippincott, Williams & Wilkins, 2009.
- Tombaugh, C.W. and Moore, P.: Out of the Darkness: The Planet Pluto. Harrisburg, Stackpole Books, 1980.
- Wallace, D.R.: The Bonehunters' Revenge: Dinosaurs, Greed, and the Greatest Scientific Feud of the Gilded Age. New York, Houghton Mifflin Company, 1999.

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