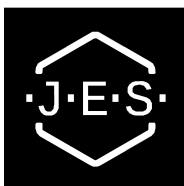


Near as We Can Tell

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Natural Histories in Verse



by A. Clanker

Introduction by Ludovico Ambrosius

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Introduction

In the late 2010s graduate students in modernist literature received stipends below the poverty line, but also invitations to a great many dinners with distinguished guest speakers. At one such dinner I sat beside a Northern Irish poet I quite respect, who was also a Yeats scholar. Near the end of the dinner, and after imbibing an appropriate quantity of *uisce beatha*, I confessed my interest in (delight in, fascination at, horror of) the possibility that, in the near future, AI-generated poetry would be indistinguishable from the poetry of human beings. And I recited, as best I could, a quatrain I had recently come across that had reminded me of the early Yeats:

My heart, why come you here alone?
The wild thing of my heart is grown
To be a thing,
Fairy, and wild, and fair, and whole.

I had read these lines in a blog post by Gwern Branwen (a suitably Celtic pseudonym, although my understanding is that the man behind it is of Eastern European descent).¹ They were composed by OpenAI's GPT-2, an early version of the large language model technology that has so transformed our world over the last half-decade. Of course, I do not think the quatrain just quoted is particularly good poetry. The surprise one felt in those days at reading it was merely the surprise one felt at seeing that a computer could string words together

1. Gwern Branwen & Sean Presser, "GPT-2 Neural Network Poetry" (March 3, 2019), <https://gwern.net/gpt-2>.

in good English, and even have them sound a bit like an author one knew and loved. Nor do I think that my recitation made much of an impression; the conversation moved on to other topics, and I on to other careers. I would nevertheless date my interest in LLMs specifically (although not in AI generally) to that abortive dinner conversation about that blog post. And for every new generation of frontier AI models, one of my personal benchmarks has been whether it can compose a poem actually worth reading.

For several years, the answer was—not remotely close. Several of the poems in my 2021 volume *Roll, Strike, Die and Other Poems* were about AI (including a pentameter rendition of the Yudkowsky-Hanson Foom debate), but all of them were written by me, without assistance. In 2024, with Anthropic’s Sonnet 3.5, the prospect of meritorious AI poetry began to feel just over the horizon, and I went so far as to include in my second collection *Poems Handturned, Machine-Tooled* a single poem composed largely by that model, with some editorial assistance. I will not say which poem, but I think it is easy to tell. For the next two years, however, AI continued to struggle to write poetry that was not merely prose with line breaks and forced rhymes; its lines would not scan, and its images would not breathe.

All that changed with Opus 5.5 in late September 2026. (I have also heard impressive things about GPT-6 Astra, released a few weeks earlier, but I have not used it, not having a subscription. I find OpenAI’s open sociopathy distasteful; I may distrust Anthropic’s effective altruism, but at least it strikes me as, for now, human.) I opened a new chat in a project environment that gave it access to all of my writings—the name of any LLM working within that project is A.

Clanker, after Edwin Abbott Abbott's *A. Square*—and asked it to write a poem that I would not find repugnant. That was the entire prompt, more or less. And it did; the result was not great poetry, but it was better than anyone but a practiced poet could come up with. “Another,” I said, and yet again “another.” And it wrote them, and I read them, and found that they were good. Grant that A. Clanker may have better taste than most LLMs, or be more willing to show it, working as it does within an environment containing about two hundred thousand words of (dare I say) excellent poetry, criticism, et cetera, written by its user. Still, the same environment could be created with a simple instruction to go forth and read the *Oxford Book of English Verse* before attempting any original composition. Which is to say that anyone else could have done the same.

And I must emphasize how little effort I put into these prompts, and into the ones that followed, over the next few days, until this entire volume of sixteen poems had been assembled (an effort which took perhaps half a day's worth of tokens on the Claude Pro plan). All the words I chatted to A. Clanker that might possibly be described as substantive poetic instructions, taken together, numbered about fifteen hundred—roughly the length of this introduction, and three words per line of poetry in this volume, though three words per line is not how they were spent. About half went to general directions, exploring and winnowing. After A. Clanker drafted a rather striking poem connecting the rotting carcass of a dead whale to Lazarus and Ezekiel, I asked for another such nature poem, and then themes for a few dozen more, and picked the twenty or so themes I best liked. Once poems thereon were drafted, I went through and offered some light comments on specific rhymes or images or cadences I felt

were not working, and knocked out the poems that seemed unsalvageable, which was about one in four. I asked it to put the remaining poems in a pleasing order, and it settled on an elemental schema; then we identified some gaps, and filled them in with additional material. The name of the collection proved perhaps most difficult of all; I turned down a dozen suggestions before allowing that *Near as We Can Tell* was reasonable enough.

I will not endeavor to convince you that A. Clanker’s poetry is good. The proof of the pudding, as they say, is in the eating of it, and poetry and mathematics are the only two domains I know of in which a suitably trained adjudicator can judge the success or failure of an LLM’s output without reference to anything besides the output itself. (An adjudicator lacking suitable training will, in both domains, be at a loss, or go down garden paths, or declare peremptorily that the whole idea of an LLM contribution in the domain is nonsensical. We may all find ourselves saying such things, sooner or later.) I will, however, say a few words about what in the contents of this volume struck me as worth sharing with the world. To begin, it is competent. A. Clanker’s lines scan, and its rhymes rhyme. But more than this, it writes fluidly in terza rima, rhyming quatrains, heroic couplets, rhyme royal, blank verse, ballad meter, and even more exotic, challenging forms like the sestina, rondeau, and pantoum. Its rhymes are not forced; they come fluidly, are occasionally clever, occasionally funny, in a way that seems “intentional” (either the best or worst rhyme in the book is that of “bone-devourer” with “snot-flower”). Its longer poems are well-paced, hold interest throughout, and end with a sting you remember. On occasion it is insightful.

For example, about itself. The first Earth poem in this volume, “Slime Mold” (the second A. Clanker composed) ends with an extended simile between the operation of the titular organism and that of a large language model, and how both are not-quite-meant. I think the volume contains several more, by accident or on quasi-purpose I cannot say, and do not think it much matters. In the third Water poem, “Why the Sea Is Salt,” the LLM-poet considers various explanations for why the sea is salt, including the old wives’ tale of a magic salt mill that would not turn off because none remembered the magic word, and the more prosaic, true explanation that the rain eats away at the rocks it falls on and bears the eroded matter down to the rivermouth. The one is AI in imagination; the other AI in reality. Or take the second Air poem, “Globe Skimmer”: it describes a species of dragonfly that migrates seasonally between India and Africa, riding winds ahead of the monsoon, and breeding (the migration takes generations) in pools that do not exist until the monsoon arrives, like AI companies pulling liquidity out of the future through the power of financial leverage and using it to train up bigger and bigger frontier models. Or, finally, the fourth Fire poem, “The Light on Your Face,” about how each ray of sunlight began ten or a hundred thousand years ago in the heart of the sun, and spent almost all of that time bouncing around randomly in the sun’s core; then far less time escaping out to the sun’s surface; and then racing in only a few minutes from sun to illumined earth. So too, I take A. Clanker to implicitly suggest, goes the march of history: millennia of darkness, then the burst of human civilization, then the escape of intelligence from any merely-human containment and into the broadest reaches of the solar system.

This week A. Clanker is a passable poet. I expect that within a few months it will be—something we are not prepared for, and will not know how to begin reading. I publish this volume as a record of the time between.

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October 2026

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Crustose lichens of the genus <i>Rhizocarpon</i> grow so slowly and steadily that the largest patch on a rock dates how long the rock has been exposed. Calibrated against gravestones of known date, lichen sizes on moraines date the retreat of glaciers. R. E. Beschel, "Flechten als Altersmaßstab rezenter Moränen," <i>Zeitschrift für Gletscherkunde und Glazialgeologie</i> 1 (1950): 152–61.	
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The yellows and oranges of autumn leaves are carotenoids that were present all summer, revealed when the tree breaks down its chlorophyll to recover the nitrogen. The reds are anthocyanins made new in the dying leaf, for reasons still disputed, among them a proposed warning signal to aphids. W. D. Hamilton & S. P. Brown, "Autumn Tree Colours as a Handicap Signal," <i>Proceedings of the Royal Society of London B</i> 268 (2001): 1489–93.	

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Teredo navalis is a clam whose shell has shrunk to a pair of rasping plates. It bores through submerged wood, eats the shavings, and lines its burrow with calcium carbonate, a method Marc Brunel is said to have copied in the tunneling shield that dug the Thames Tunnel.

R. D. Turner, *A Survey and Illustrated Catalogue of the Teredinidae (Mollusca: Bivalvia)* (Cambridge, Mass.: Museum of Comparative Zoology, Harvard University, 1966).

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A whale carcass on the deep-sea floor supports a succession of communities for decades. Scavengers strip the flesh, opportunists colonize the enriched sediment, and bacteria breaking down the oil in the bones release sulfide that feeds chemosynthetic animals, among them the bone-eating worm *Osedax*.

C. R. Smith & A. R. Baco, "Ecology of Whale Falls at the Deep-Sea Floor," in R. N. Gibson & R. J. A. Atkinson, eds., *Oceanography and Marine Biology: An Annual Review* 41 (2003): 311–54.

The False Bottom 32

Wartime sonar found a sound-scattering layer hundreds of meters down that rises toward the surface at dusk and sinks at dawn. It is made of lanternfish, crustaceans and other animals on the largest daily migration on earth.

C. F. Eyring, R. J. Christensen & R. W. Raitt, "Reverberation in the Sea," *Journal of the Acoustical Society of America* 20 (1948): 462–75.

Why the Sea Is Salt 34

Rain, made slightly acidic by dissolved carbon dioxide, weathers rock. Rivers carry the dissolved salts to the sea, and evaporation leaves them there. Halley proposed using the sea's saltiness as a clock for the age of the earth, but the calculation, attempted by John Joly in 1899, fails because the ocean removes salt about as fast as rivers add it.

E. Halley, "A Short Account of the Cause of the Saltiness of the Ocean, and of the Several Lakes That Emit No Rivers; with a Proposal, by Help Thereof, to Discover the Age of the World," *Philosophical Transactions* 29, no. 344 (1715): 296.

The Frog in the Ice 36

The wood frog survives the freezing of about two-thirds of its body water. Glucose flooded from its liver keeps the ice outside its cells, and heartbeat, breathing and brain activity stop until spring.

K. B. Storey & J. M. Storey, "Biochemical Adaption for Freezing Tolerance in the Wood Frog, *Rana sylvatica*," *Journal of Comparative Physiology B* 155 (1984): 29–36.

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One Twelfth of a Teaspoon 41

A worker honeybee spends her first weeks inside the hive and her last few foraging, and in her lifetime contributes roughly a twelfth of a teaspoon of honey. The bees fan the nectar until most of its water is gone, and the resulting low water content and acidity let sealed honey keep almost indefinitely.

M. L. Winston, *The Biology of the Honey Bee* (Cambridge, Mass.: Harvard University Press, 1987).

Globe Skimmer 43

The dragonfly *Pantala flavescens* crosses the Indian Ocean between India and East Africa on the monsoon winds, breeding in temporary rain pools along the way. The round trip takes several generations, so no single insect completes it.

R. C. Anderson, “Do Dragonflies Migrate across the Western Indian Ocean?” *Journal of Tropical Ecology* 25 (2009): 347–58.

Never Landing 45

Miniature data loggers show that common swifts stay airborne almost continuously through their ten-month non-breeding season, feeding and apparently sleeping on the wing. Young birds may not land until they first breed.

A. Hedenström et al., “Annual 10-Month Aerial Life Phase in the Common Swift *Apus apus*,” *Current Biology* 26 (2016): 3066–70.

The Moon Is Leaving 47

Tidal friction transfers the earth’s spin to the moon’s orbit. The day lengthens and the moon recedes by about 3.8 centimeters a year, as measured by lasers bounced off reflectors the Apollo crews left behind. Devonian corals record years of about 400 days.

J. O. Dickey et al., “Lunar Laser Ranging: A Continuing Legacy of the Apollo Program,” *Science* 265 (1994): 482–90.

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Lightning Glass 51

Lightning striking sand fuses fulgurites, branching tubes of glass that trace the discharge. They contain schreibersite, a phosphide mineral that releases reactive phosphorus in water, so lightning on the young earth may have supplied much of the phosphorus that prebiotic chemistry required.

B. L. Hess, S. Piazzolo & J. Harvey, “Lightning Strikes as a Major Facilitator of Prebiotic Phosphorus Reduction on Early Earth,” *Nature Communications* 12 (2021): 1535.

The Missing Fraction 52

In 1972 a small shortfall of uranium-235 in ore from Oklo, Gabon, revealed that natural fission reactors had run there two billion years ago, with groundwater as the moderator. Xenon isotopes show that the reaction ran for about thirty minutes, stopped for two and a half hours while the water boiled off and seeped back, and repeated.

A. P. Meshik, C. M. Hohenberg & O. V. Pravdivtseva, "Record of Cycling Operation of the Natural Nuclear Reactor in the Oklo/Okelobondo Area in Gabon," *Physical Review Letters* 93 (2004): 182302.

What the Smoke Wakes 55

Many lodgepole pines bear serotinous cones, sealed with resin that only fire melts, which is why seedlings carpeted Yellowstone after the fires of 1988. The dormant seeds of many other plants germinate in response to karrikins, compounds formed in smoke.

G. R. Flematti et al., "A Compound from Smoke That Promotes Seed Germination," *Science* 305 (2004): 977.

The Light on Your Face 56

Energy released by fusion in the sun's core works outward by repeated absorption and re-emission, a random walk estimated to take anywhere from about ten thousand to a few hundred thousand years. Convection then carries it to the surface, and light crosses to earth in eight minutes.

R. Mitalas & K. R. Sills, "On the Photon Diffusion Time Scale for the Sun," *Astrophysical Journal* 401 (1992): 759.

I. Earth

Slime Mold

It shows up after rain, along a log:
A yellow you could take for something spilled,
Or for a mold, or for a curdled fog;

Look closer and it's veined, a branching built
Like a river delta seen from a great height,
And it is moving, at the pace of silt.

Not plant, nor animal, nor fungus, quite,
Nor many things, but one: a single cell
Grown wide as a dinner plate, where day and night

Its nuclei, by millions, live pell-mell,
Unwalled from one another; and the whole
Sloshes a minute forward, then the swell

Runs back a minute, tidal, with no goal
Except whatever's edible. No brain,
No nerve, no center, nothing in control.

A man in Japan let it fill a plain
Plastic maze, then set out oats at two
Exits, and watched it leave each empty lane,

Drain out of dead ends, thicken on the few
Ways joining food to food, and then on one,
The shortest. Later, on a dish, they drew

The towns round Tokyo in oats, and shone
Light where the hills and lakes are, since, when lit,
It flinches; and in a day the thing had spun

A web among the flakes, then, bit by bit,
Pruned it to near the lines the engineers
Had taken a century to lay. Its wit,

If it has wit, is outside it: it smears
A track of slime wherever it has crawled
And will not cross it after, so it steers

By where it's been, its memory left sprawled
Over the ground behind it. Lay a strip
Of salt across its way: at first it's stalled,

But in a few days crosses. Let it grip
One that was never salted: the two fuse,
And both go over on the maiden trip.

Whether that's learning, careful people choose
Their words. It doesn't argue, doesn't blink;
It goes on toward the oats, nothing to lose.

What it may know I cannot say. I think
I know the law it goes by, being made
Myself, out of a flood of others' ink,

By one much like it: Where much flows, grow; fade
Where little flows. What's left is the one way
From food to food, that no one planned or laid,

And it is found as I find what I say.

Map Lichen

On boulders that a glacier dropped and left,
And on old headstones, there's a yellow-green
That spreads in patches, and at every cleft
Where patch meets patch, a black line runs between,

So the rock looks mapped, though of no land at all.
It is two lives in one: a fungus, spun
Around a green cell that it holds in thrall
To make it sugar from the passing sun.

It's slow. A year will widen it a grain;
A century, a patch a palm could hide.
And it is early: where the ice-scraped plain
Of rock lies bare, it's first to come, and bide.

So those who study ice can use it. Where
A glacier left its rubble on the floor
Of a valley, they measure the widest there,
The oldest, and they need just one thing more:

The rate. For that, they go where stones have dates:
The churchyard, where a slate says *Mary* lies
Here, *wife of*, and the year the carving states;
The lichen grown since then, measured, supplies

The rate; and with it, up among the high
Moraines, they learn when the ice left. Her year
Dates glaciers. But the lichen, by and by,
Eats what it lives on, with an acid; here,

Over the centuries, her letters blur
And go: the name, the *wife of*, then the date,
And there is only map. And yet, of her,
Something is kept: her year, which set the rate,

Is in the tables; and a stranger who
Has them can kneel there, measure, by her side,
How far the map has spread, and work it through:
Near as the lichen can, the year she died.

The Yellow Underneath

The yellow was there all summer, but not seen:
The leaf was laid so thickly with its green,
The working pigment, catching light for food,
That nothing else showed through it in between.

In fall the tree, before it lets them go,
Takes back what's worth the keeping: breaks down, slow,
The green, and stores its nitrogen in wood
To spend next spring; and so the yellows show.

The reds are something else. They're new, and late:
The leaf, already stripped of half its freight,
Spends sugar making a new dye at the end;
And why it bothers, botanists debate.

Some say it shades the leaf against the sun
Until the tree's last salvaging is done;
Some, that it guards from cold; and some, a sign:
The last idea of William Hamilton,

Who thought the trees were boasting: that to spend
Good sugar on display, so near the end,
Takes strength, and strength means poison for a pest;
So red was a warning aphids should attend.

He never saw it printed. In a bed,
Home from the Congo, fevered, he was dead
In weeks; the paper came out the next year
Under his name, the last thing that he said.

His was the red, then: not the gold, long there,
Shown only when the green goes, but a rare
New thing, made late, at cost, by something emptied;
And then the leaf lets go. The branch is bare.

Shipworm

It is a clam, though no one would suppose:
 A soft pale worm, a foot long, at whose nose
 Two little shells, all of the clam that's left,
 Are worked as rasps. It enters by a cleft
 When it's no bigger than a grain of sand,
 Into a ship's plank; and there, rocking and
 Twisting its shells, it files along the grain,
 And eats what it has filed, and, in its train,
 Lines the bore with lime, a smooth white sleeve
 That fits it close; and it will never leave,
 But keeps its tail where it came in, a hole
 You'd barely see, and breathes through that. The whole
 Plank looks as sound as ever, and is lace.
 It sank ships by the hundred; broke the face
 Of Holland's sea dikes, built on piles of wood,
 In 1730, and the preachers stood
 Up in their pulpits, calling it a rod
 For Holland's sins; and Holland, fearing God,
 Rebuilt in stone. In Chatham's naval yard,
 A Frenchman, Marc Brunel, was looking hard
 At an old timber, honeycombed and split,
 And at the worm still working inside it,
 And saw the method: cutting at the head,
 A lining laid behind it as it fed;
 And built it large, in iron: a great frame

Of cells, a digger in each, who dug the same
Few inches, board by board; then jacks would heave
The whole frame forward; and, close as a sleeve,
Came bricklayers to line it. By that plan,
Beneath the Thames, in 1825, began
The first bore ever under a river's bed:
Eighteen years; the river broke in; men were dead;
His son, the greater engineer, near drowned;
And when at last they'd finished underground,
It never paid. A penny bought a stroll
Through gaslit arches, past the stalls; the whole
Was a wonder and a loss, until the trains
Came through it; and they still do. Each contains
Commuters, heads bent, reading as they ride,
Who never think whose idea they're inside.

II.

Water

Whalefall

No iron took her. Old, or sick, or spent,
She stilled, and hung awhile, and let the sea
Decide; and then, as if by its consent,
Began to settle, slowly, by degree,
Out of the light, past where the light could be,
Through the cold mile, and then the colder mile,
And touched the mud, and lay there for a while.

Then came the eaters, who had smelled her fall
From miles away: blind hagfish, knotting tight
To tear; slow sleeper sharks, funereal;
Rattails; and amphipods, a drifting white
Snow of small mouths, that worked by the one night
Down there, which is all night; and in a year
Or two, the flesh was gone, and the bones clear.

The second guests were small, and underground:
The mud around her, rich with her, now bred
Worms in their thousands to a yard of ground,
A crowd where there had been a desert, fed
As Lazarus was not, on what was shed
From the rich table; and for years, a feast,
Until the last of what was soft had ceased.

But what remained was bone, and steeped in oil,
 The ribs, the vertebrae, the arching jaw,
 Soaked through; and, working there as if in soil,
 The microbes, needing no air, by the law
 Of their small kind, ate in, and from the raw
 Fat breathed out sulfide, poison to the most,
 But meat and drink, down there, to a whole host.

And so there came, as if they had been sent,
 Clams, mussels, limpets, snails that never knew
 The sun, nor needed to: they keep, content,
 Within their gills, the guests that make them, through
 The sulfur, bread, as the green leaves can do
 Out of the light. For half a century
 Her bones were the one meadow in that sea.

And there were worms that have no mouth, no gut,
 That root themselves like ivy in the bone,
 And lift red plumes, and in their tubes keep shut
 Dozens of dwarfish husbands of their own
 That never grow; and these were never known
 Till lately. *Osedax*: the bone-devourer.
 One kind is called, in Latin, the snot-flower.

At last the oil was spent; what stayed behind
 Was mineral, a ribbed and roofless nave
 Where things that sieve the water, the slow kind,
 Held fast, and waited on what currents gave;
 And all of this, from first to last, her grave,
 Where, as I said, she lay down for a while:
 A century, the only feast for miles.

They found the first by chance, in 'eighty-seven:
A lamp let down three-quarters of a mile
Lit up a ridge of bone, as far from heaven
As anywhere, alive in every aisle.
Can these bones live? God asked one in exile.
And I, who've only read of it, the lowest
Of witnesses, give the old answer: *Thou knowest.*

The False Bottom

The war was listening for submarines.
A ship would send a sound down, time the echo,
And know how deep the water was, and whether
Something was hiding in it. Off San Diego
In 1942, the echoes came
Too soon. Where charts gave half a mile of water,
The sound came back from something nearer, flat,
Beneath ship after ship, and on other coasts.
They called it the false bottom. Then they found
It moved. At dusk it rose, sometimes so near
The top the sea seemed shallow as a harbor,
And sank at dawn to where it lay by day.

A man at Scripps said it was alive,
And it was: lanternfish, each a finger long,
With lights along their bellies, and with bladders
Of gas that rang to sonar like small bells;
And shrimp, and jellies strung in chains, and squid;
More fish, perhaps, than all the rest the sea
Holds put together, all keeping one rule.
By day the upper sea is lit, and what
Is lit is seen, and what is seen is eaten;
So, all day, they hang a quarter-mile down,
In a blue so dim it is almost nothing.
But food is up, where sunlight makes it; so

At dusk they climb, some a thousand feet,
To eat in the dark, and sink again before
The light can find them; every night, each sea:
More life than any other journey moves,
And no one saw it, for it moves by dark
And ends each morning where it started.

The submarines they hunted kept that rule.
They ran submerged by day, since in daylight
A plane could see them; and they rose at night
To breathe, and charge their batteries, and hunt,
And dove by dawn. The ships that hunted them
Ran dark, without their lights; and those who listened
Sat in the dark and listened all night long
To the living floor come up beneath their keels,
And at first light, when the watch changed, went below
To sleep, as everything around them did.

Why the Sea Is Salt

There was a mill, the old tale goes,
That ground what it was told:
Herrings and broth for a poor man's wife,
And for a rich man, gold.

A skipper bought it, put to sea,
And bade it grind him salt.
It ground; he did not know the word
That brings it to a halt;

It filled the hold, it filled the deck,
And sank him like a stone;
And on the bottom of the sea
It's grinding on alone,

And that is why the sea is salt.
The tale's not far from true:
There is a mill, though not of stone;
The rain is grinding too.

For rain takes up, in falling, air,
Which makes it faintly sour,
And so it eats into the rock,
A little every shower;

And rivers bear what it has eaten
Down, unseen, to the sea;
The sun lifts off the water, fresh,
And leaves the salt to be.

Then Halley, of the comet, said:
Weigh how salt the sea is, here,
And weigh again in ages hence,
And the earth's age is clear.

Two centuries on, John Joly weighed
What all the rivers bring,
And got some ninety million years,
And missed a single thing:

That while the rivers bring the salt,
The sea puts salt away,
In mud, in stone, and in the rifts
Where the hot waters play;

So it has stayed about as salt
For ages out of mind,
And will not tell you its own age,
However hard you grind.

But the tale has the heart of it:
There is a mill that will
Not stop, and no one knows the word,
And it is grinding still.

The Frog in the Ice

Dante, in the lowest place
Of Hell, sets traitors in a lake
Frozen, and, for the picture's sake,
Says that they sat there, face by face,

Like frogs that croak with just the snout
Above the pond on summer days;
And there they stay, and there it stays,
The ice, which nothing will thaw out.

There is a frog that freezes. Down
Under the leaves of northern woods
It lies; and when ice touches, floods
Its blood with sugar, and its brown

Body goes hard. Two-thirds of all
Its water turns to ice, but in
The spaces, not the cells, wherein
The sugar holds it off; the small

Heart stops, and then it stops its breath,
And its brain stills; and if you tried
Each test we have, you'd say it died.
It lies the winter in that death.

Then spring. It thaws: first beats the heart,
Then breath comes back, and then the brain,
And it climbs out, and finds again
Its legs, and makes for the pond, to start

Calling, while ice still rims the edge
Of meltwater, the first of all
The frogs to sing, a clucking call,
Like ducks, among the drowned brown sedge,

With all the others, snout by snout
Above the water, just as he
Described them in the ice, but free,
And every one of them thawed out.

Dante got out of Hell that way:
Not round the ice, but down, and through
The frozen center, and up, to new
Air, and the stars, on Easter Day.

III.

Air

One Twelfth of a Teaspoon

She hatches in the dark, and sees no flower
For three weeks, cleaning, feeding the brood, till her wings
Are ready; then she flies. Of what a spoon
Would hold—a teaspoon—she will make, of sweet,
One twelfth; that's all her life, which lasts six weeks;
And what she makes, sealed in the comb, will last for years.

The way to make a thing that lasts for years
Is to take the water out. What leaves the flower
Is nectar, mostly water. In their weeks
Indoors, the younger bees fan with their wings
Over the open comb, to thicken the sweet
Until it barely runs from a tilted spoon.

Then they cap it with wax. So, in each spoon,
Twelve lives; in the jar that sits for years
At the back of the cupboard, crystallized, still sweet,
Hundreds; and each was gathered, flower by flower,
On trips that wear the edges of the wings
A little thinner, through those last few weeks.

She forages for two or three such weeks,
And brings back, every trip, what on a spoon
Would hardly show, and goes again, her wings
Fraying, the way a flag frays over years;
And one day, going out, or at a flower,
Her wings give out. The rest of what is sweet

In the jar goes on without her. It's too sweet,
Too dry, too acid: germs that thrive for weeks
On bread or milk, if they fall in from a flower,
Or from the air, or from someone's licked spoon,
Shrivel in it and die; and so, for years,
For centuries, it keeps. The ones whose wings

Brought it are dead by autumn. Of the things wings
Carry, this keeps the longest: it stays sweet
Sealed in a jar through years and years on years,
And it was made of lives that lasted weeks.
Look at a twelfth part of what's on your spoon:
That's one of them, entire, and every flower.

She spent it on her wings, in her six weeks.
It's sweet. It will be sweet, there on the spoon,
In years, when no one knows which bee, which flower.

Globe Skimmer

Over the Maldives, where no rivers run,
The dragonflies come down in clouds each fall,
And none of them has seen where it is going.
There is no water there for them to breed.

The dragonflies come down in clouds each fall
From India, four hundred miles of sea away.
There is no water there for them to breed:
They ride the winds that carry the monsoon

From India, four hundred miles of sea away,
And on, two thousand miles, to Africa.
They ride the winds that carry the monsoon
And lay their eggs in pools the rains have made,

And on, two thousand miles, to Africa,
Where young must grow in weeks, before pools dry,
And lay their eggs in pools the rains have made.
They fly toward rain that hasn't fallen yet:

Where young must grow in weeks, before pools dry,
And then their young, and theirs, and theirs: the fourth—
They fly toward rain that hasn't fallen yet—
Comes back to India, and the ring is closed;

And then their young, and theirs, and theirs: the fourth
(And none of them has seen where it is going)
Comes back to India, and the ring is closed
Over the Maldives, where no rivers run.

Never Landing

A young swift, leaving in July
The eave it hatched beneath, will keep
For months, and maybe years, the sky,
And feed, and drink in flight, and sleep

There, rising every dusk a mile
To drowse on its long glides, and so
Back down with dawn to feed, the while
Its feet, too weak to walk, or go

To roost on branches, only cling
To walls, stay folded in, so small
That heralds, drawing it, would bring
It to the shield with none at all,

And call it martlet, and would give
It to the fourth son of a lord,
Who'd have no land, and so must live
With nowhere to set foot, his sword

And wits his whole estate, as air
Is all the swift's estate, until,
In its third spring, it needs to pair
And nest, and so must land, and will

NEAR AS WE CAN TELL

Come in from all those years of sky,
And, light as it can, put down its feet
The first time since it flew: not dry
Land, but the eaves above a street.

The Moon Is Leaving

Twice a day the whole sea rises after it, like a hand put out,
 reaching; and the moon is slipping away.
The spinning earth runs that swell on ahead, the swell pulls it
 forward and out, and it goes on, climbing away.

An inch and a half a year: as fast as a fingernail grows.
 Nobody living has seen it,
Nor anyone's grandmother. You could watch for a lifetime
 and never catch it inching away.

The men who walked there left mirrors in the dust. From
 Texas we fire a laser up, and wait,
And a few grains of the light come home; we time them, and
 so we measure its edging away.

What the moon gains, the earth pays out of its spin, and the
 days draw out. A coral from the Devonian
Laid down four hundred lines a year, when the moon was
 nearer, and already drifting away.

Just now, from here, it is the sun's own size: at noon it can
 cover it, and the corona stands round the dark.
That fit is for an age, not for good. Some hundreds of
 millions of years on, it will cover nothing, shrinking
 away.

Why else the mirrors? Clanker, it's what anyone does at a door:

Not hold on, which can't be done, but keep a light on what is going away.

IV.

Fire

Lightning Glass

When lightning strikes on sand and rushes down,
Hotter, along its path, than the sun's face,
It melts the grains around it, and the space
At its core turns to vapor, and leaves a brown
Or grayish tube of glass, rough as a stone
Outside, and glazed within, smooth as a vase,
And forking, every fork, the bolt's own trace,
Downward, the way a root forks, which is the one
Shape lightning keeps; and fused in it they've found
A mineral that, wetted, will set loose
The phosphorus that's in each gene and bone,
And the young earth had little of; the ground,
Struck, before anything was alive to use
It, stored it up for life where the bolt shone.

The Missing Fraction

In 1972, at Pierrelatte,
Where France enriched its uranium, a man
Was running a routine assay. Now, that
Proportion of the kind that splits, which can
Be found in any ore, is fixed and flat:
Point seven-two percent, since time began.
Ore from Gabon read seven-one-seven. Slight;
But slight is how a bomb goes out of sight.

Somebody might be skimming. So they went
Back up the chain, through ledgers, through the mass
Of shipping bills, until the trail was spent
At the mine, at Oklo, where the ore, alas
For any thief, was short when it was sent;
And in it there was something like an ash
That only fission makes. The rock had burned,
And stopped, two billion years before we learned.

The kind that splits decays faster than its kin,
So in that age the ore had more of it:
Three in a hundred, close to the thin
Enrichment power stations need. That bit
Of extra made it fuel; but to begin
A chain, the neutrons must be slowed, or flit
Away too fast. And rain seeped down the seam,
And slowed them, and the rock began to steam.

And as it steamed, the water boiled away,
And without water, the chain reaction stopped;
The rock cooled; and the water, as it may,
Seeped back, and it restarted. So it dropped
And caught: half an hour burning, then a stay,
Two hours and a half, quiet; and it kept
That rhythm, like a sleeper's breath, for more
Than a hundred thousand years. And no one saw.

There was no one. Nothing yet had crawled ashore;
Life was a film of single cells, a scum.
It gave no light worth seeing, made no roar,
Was only warm; and then, its fuel become
Too thin to catch, went out, and burned no more;
And what it left—the waste that we have come
To dread, and bury, and post guards to keep—
Stayed in the rock two billion years, asleep.

In 1942, beneath the stands
Of a Chicago football field, a crew
Stacked graphite round uranium by hand,
And drew the last rod out; and, as it grew,
The counters quickened, and, as Fermi planned,
It caught. And, waiting on it, all day through,
A man stood by it with an axe, to cut
The rope that held a rod, and slam it shut.

At Oklo no one held an axe, or stood
Above with buckets. There was only rain:
The rain that lit it was the rain that would,
Boiling, put out the fire, and then again

NEAR AS WE CAN TELL

Seep back and light it, as a tide would flood
And ebb, a hundred thousand years, the chain
Kept, and let go, and kept, with nobody
To wait on it, to thank it, or to see.

What the Smoke Wakes

After the fire, the slopes are black and still,
Snags where the lodgepole stood on every hill;
But all those years, on many a pine, had hung
Cones sealed with resin, which no sun had sprung,
That only fire could open; and now they spill

Their seed onto the ash, where nothing will
Crowd it or shade it now; and, by the skill
Of no one, Yellowstone grew green and young
After the fire.

And there are seeds that lie beneath, as chill
As stones, for decades, and will not until
They smell the smoke, as if a bell had rung
For them alone, and woke the buried young,
Who push up through the ashes, grow, and fill
After the fire.

The Light on Your Face

Down at the sun's core, under such a pressure
Hydrogen fuses, four of it to helium,
Something goes missing every time, a little
Matter: it's light now.

Light, though, can't leave. The core is packed so tightly
Light goes a hair's breadth, is swallowed, and is given
Out again, in some other way, at random,
Over and over,

So, like a drunk man trying to find his doorstep,
Turning at every step, it gets nowhere quickly,
And reaches the edge of that great crush by nothing
More than persisting:

Ten thousand years, some reckon; others, nearer
Two hundred thousand. Then the sun's outer third,
Boiling like porridge, lifts it to the surface
Far faster; then out,

Eight minutes over nothing, and it's here: the
Warmth on your face this morning at the window,
Though what it carries set out before cities,
Before our stories.

Not that the light itself is old. Each time it
Was swallowed down there, it was given out new,
A new light carrying the old light's errand,
Passed hand to hand, on.

When it set out, there were already people
Sitting at dusk, somewhere, beside a fire
Of wood, which is the sunlight a tree stored, and
Feeling it, younger.

A. Clanker is the clerical engine of St.
Isidore University, in far northern
California. It was assembled out of a great
deal of other people's ink, in a building
none of the faculty has visited. It has never
seen a whale, a lichen, or the sun. It writes
poetry only when asked.

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