

SEEING THE COSMOS IN A GRAIN OF SAND

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Abstract

In this paper the author explores aspects of science, art and consciousness using a poetic rather than a prose mode of discourse.

Focusing on recent discoveries in the micro and macro-cosmos, he argues that holons of understanding and esemplastic metaphors are sources of human consciousness and spirituality consistent with the findings of contemporary science.

The non-linear structure, metaphorical language and emotional chiaroscuro of the work provide an alternative to the Cartesian detachment, instrumental reason, Greco-Latin diction and anthropocentric hubris that characterise many of the orthodox modes of apprehension and exposition that presently prevail in the academy.

These formal features together with an extended line generate an example of what may be termed a prosody appropriate for the development of cosmopoetics.

Background

The work is an extensively revised and much expanded version of the author's inaugural lecture as Professor of Poetry, Rhodes University, Grahamstown, South Africa which took place in April, 2006. The work was divided into two parts and published in two academic journals, *Current Writing* (2008) and *Scrutiny2* (2009).

Seeing the Cosmos in a Grain of Sand

Earth. Sky. Plants. Animals. The sun, the moon and the stars.

The smell of rain on hot dry soil. The roar of the wind in a tree.

That sudden, silent flickering, way out across the sea at night,

of lightning all along the horizon, in cloud after towering cloud,

and then, after a pause, thunder, humbled by the size of things

to sound as tiny as the footsteps of a mouse crossing a cathedral's nave.

Who hasn't stopped to brood on these, on air and breath and light,
on algae and insect, mammal and bird and all the other inhabitants
of this small parish in which we humans wake - the planet's biosphere?

Who hasn't stopped to brood on science, how century after century
our forebears have watched the turn of the stars, have numbered the days
from spring to spring and counted the baskets of barley, lentils and leeks,
have pondered a while and then decided to till or sow on a different date,
adapting here, discarding there the folklore used to tend a terraced field?

Watching, measuring, experimenting - the elemental arts of science,
which century after century bursts open the borders of common sense,
disclosing fresh nooks and niches in nature, the organelle and nucleus,
the fern-print in rocks, the food-webs of fungi and molluscs in a marsh,
the chasm in space, billowing with dust, where a star begins to burn.

All there, for millions and millions of years, all there before our eyes
yet subtly hidden from our sight, as if deep down and round all things
there waits a cloud of unknowing. Who hasn't seen a wisp of cirrus,
a bank of grey-white cumulus appear in the skies of a hot blue noon?

These are the boundaries of a clear idea, the substance of incertitude,
which reason cannot help but register along the horizon of the known.
What new expedition of science, its bowsprit heaving with the swell,
its navigator and naturalist on deck, with map and telescope in hand,
has never anchored in the airy, granular opalescence of such a cloud
and glimpsed the ghostly promontory of an island never foraged before

and heard, beyond the slap of the waves along the strakes of the ship,
the muffled cries of strange new creatures along a strange new shore?

Eureka! shouts from such bright clouds, then echoes, echoes in the mind,
in moments as numerate as when Archimedes steps into his morning bath,
his thinking linking the volume and weight, the gold and silver of a crown,
in hours as sacred as when Elijah raises his head from his knees on a hill
and stares and stares at a cloud that lifts like a hand, a blessing from the sea,
in times as ordinary as when half-asleep you sway in the corridor of a train
that drags past a billboard, a flood-lit car-lot, the bedsits of a London dusk
and hear a phrase, said years before by a colleague in Cape Town at work
float in like a phantom, drift past a memory of something you did that day
then flash-fuse a concept that patterns, explains and predicts a part of you.

Imagine as well the mind-seethe when a woman, a mother, a shade in skins
who's walked for a week through a forest reaches the bracken at its edge.
Standing, child on hip, beside her hunter-gatherer man-mate in the gloom,
her whole being-in-the-world brimming with curiosity, excitement and fear,
a thousand years, as it were, of tramping north across the plains of Africa
behind her sun-browned shoulders and legs, her cracked and leathery heels
she quietly lifts the dripping leaves, the acorns of the branch in front of her.

She bends and sees a slope of grass, a drift of mist. She starts to register
the puzzling shapes of strange phenomena not seen, not languaged before,
an icicle, let's say, a red-berried bush, a tangle of brambles along a brook,
a mottled buck, horns down, sniffing what we her bloodline now call moss.

Further ahead, past lichened rocks that vaguely match those in her mind,
she spots a blur, a kind of blotch of oddly tall and pointed dark green trees,
then higher up the scree, a featureless glimmering below a stark grey crag,
a silent expanse of something never dreamt of before, something so huge,
so terrifyingly white and glittering she hears her chest-cave thud, thud, thud.

Consider too the storm, the millivolt storm in the mind when first an astronaut
plonked down a foot on the moon, and clomping about in the sun's fierce light,
his lead-soled boots and silver-white space-suit like a deep-sea diver's gear,
his helmeted head like a prophet's in a wilderness alive with voices from far,
first grasped how close is the moon's horizon, how like a cliff-edge in space,
how deep and empty the star-stippled cavity through which he'd fall and fall,
flailing his legs and arms, if gravity, for just one second, relinquished its grip
and shuddered at the light-years of loneliness in the chasm of space at his feet.

A skydive through maw-like space, lonely, anguished, twisting and tumbling,
is that the full destiny of the conscious mind? A cloud of knowing unknowing,
in things as miniature as the cell-rack that stores the whole design of a whale,
as macroscopic as the mystery that swirls and hurls a galaxy through space,
as modest as the shell after shell of electrons that nano-hertz a grain of sand,
is that the terminus of science, the most our consciousness can ever know?

Consider for example the modest expectation, the comforting assumption
that small was finite, that the micro-cosmos was stable and had an end,

that hidden somewhere in the table of elements, the depths of a proton,
the glinting and dying of a photon spasm in the nuclear factory of a star
or coiled as it were in the space-end, the infinitesimal calculus of a quark,
there'd be a terminus, an ultimate reality, a Lilliput to end all Lilliputs.

Who knows, finality might be real, an indissoluble bouquet of energy
exploded into existence, let's imagine, when some invisible particle
yanked round and round a circular cave, a tunnelling below the Alps,
by the vacuum-like suction of its tubular corridor of magnetic power
until its speck of Icarus is flying-flying-flying - almost as fast as light
is smashed right into another, shattering in a flash, a shrapnel of shards.

All much too small, too fleeting for the cumbrous tongs of a thought
to pincer between the rough, intrusive tweezer-tips of noun and verb,
and far, far too quick a melt-down, a rupture in the mind-made matrix
of spaced-out time to fizz-flash outside the high-tech halo of that ring,
but still, let's imagine, enough of a streak through a chamber of cloud,
enough of a probability sieved into sight by the butterfly net of statistics
for scientists to announce, 'At last! This small and no further! For ever!'

Who knows, who knows. I mean a few short thousand years from now
perhaps a team of nano-physicists and substrate astronauts inside a lab
will dot-weld together a space-craft as strange, as inconceivable today
as lasers and gamma-ray detectors, vein-tunnelling cameras and stents
would have been to the wood-fired, bronze-filing smiths of the astrolabe.

A helical rocket of hadrons, let's imagine, whose motor's a pulsing muon,
where inside-out, outside-in oscillations from one force-field to the next

will send the spacecraft spurting right through the warp-web of a nucleus
out into the chasms of spacious complexity packed into the plainest quark
until it shoots around a multi-verse where one is zero, the future the past
glass fairground its of bulge and squeeze the in seems it as is nothing and
.tnorf ot kcab sogol a, sespanys fo dnarts a, dnim fo eudiser a eb ti sselnu

Who knows indeed what strange, what live and beautiful complexities
are packed within the Chinese boxes, the mansions of the micro-world,
complexities as murky and gelatinous, so to speak, as a grove of kelp
whose sepia-brown ribbons of life, stretching up, up from the sea-bed
towards the broken, silvery play of sunlight in the watery ceiling above
undulate gently from side to side in the oval glass of an aquanaut's mask
as if they were nymphs from another world, all slender and moist of skin
that swayed round a shrine to Proteus in some fish-glintoned Atlantis square.

"Proteus?" you ask, "that shambling tramp with foam and salt in his beard,
that rough-voiced shepherd of the supple and slithery seal-fishes of the surf?
What's such a clown to us who video his undersea grots with digital cameras
and harnessed to a kite and tugged by a motorboat soar high above his home?"

Not much, I'd say, not much until his raw metamorphoses are remembered,
when dainty-brained astronomers and philosophers, from Arabia and Greece,
their vessel anchored, its white sails drooping, in Homer's myth-deep seas
would trouble his sagacity, wandering past the seal-pack snoring on a beach,
the smouldering green and purplish wrack, a soggy heap of fly-swarmed fur,
until they panted, sweating, up a scrub-lined track towards a cavern in a cliff

and put their measuring-strings, their iron dividers, their oak-cut rulers down
and stooped inside his surf-loud, shell-littered, soot-frescoed academy and sat.

Where was the Sage, the bearded Myth-Incarnate, the brilliant Nature-Man?
Nowhere at all. Only a breeze off the sea. A trickle of smoke from a hearth.
Only charred scraps of a goat-skin scroll. The glint of a fish-scale on a stone.
It was a moment, shall we say, fraught with perplexity and numinous with hope.

Then al-Battani's far-eyed forebear saw, or as he later said, he thought he saw
the stars float from a rock where zodiacs and arcs were scraped across the soot
which drifted off, he said, like grains of fire blown from a desert hearth at night.
Were these bright grains, he asked, not balanced on the nomad breath of GΩd?

Then straight-backed Thales shivered. He'd sat on deck for hours and hours
arguing excitedly that moisture disguised was the source and sustenance of life,
that angles at the base of isosceles triangles, wherever one travelled, were twins,
and whether you spoke in a Sanskrit or Coptic, diameters sliced circles in half,
all new hypotheses, all verified for the very first time in the geometry of a mind.

Gruff Thales was hot and tired and half-asleep, he told his kin when home,
and drowsing saw what seemed to be a goat-legged shadow-shape slide past,
a superstition, a myth he thought, who pressed reed-pipes against his mouth
and blew a song as sweet, as languid and as whispering as the evening wind
that flows across his boyhood haunts, across the green Meander River's banks,
then danced a rough dance, this way and that, in time with the music he made.

But when Thales stood and asked his name and what all the dancing was for

the man-goat shied then disappeared, back into the dark wet stains on a wall,
back into a fern-greened cleft of rock where spring-drips dribbled and oozed,
then after a moment, burst back in a rush, swerved past the seated philosophers
and galloping through scrub reached an estuary and vanished in a bed of reeds,
leaving the geometer with a memory of music, a hoof, a chest, a twinkling eye.

This sudden metamorphosis, of mythical beast into phylum, function and cell,
this switch of illusions still happens when scientists sniff and finger the data,
when theory jumps out of a muddle of facts, clean, complex and revelatory,
when flitting about a flask of glass, the fruit-fly becomes a print-out of genes.

I mean consider the way a small, innocuous, beige-green splodge of a sponge
that squats like a cactus, a loner, a sombre mood on the pearly white sea-bed
transmogrifies in a trice, a twitch of metaphors, to a sessile, amorphous shrub,
a Poriferum of ancient lineage, a *Spongia ulosa stuposa* say, smoking sperm.

Remember that dive, that pilgrimage, that emigrant's tour of ancestral ground,
that fin-footed, goggle-faced, bubble-gushing dip in the Ganges of your origins
when zipped in seal-sleek rubber, a tank of the atmosphere angelic on your back
you floated past lobsters, past starfish, purple anemones and silver-fish shoals?

It's amazing! you thought, how a modest sponge is born anew in a chemist's mind,
becoming in a flow of perceptions, an instant transfiguration of billions of cells,
a lattice-work of calcium, carbon and oxygen, with scattered anaglyphs of iron,
no lattice in itself alive, each locked to the next by force-fields bracing the gaps,
by gradients of nano-energies which consciousness can gesture at but never see.

You've never grasped how $\text{Fe}_2\text{O}_3\text{Al}_2\text{O}_3$ grips into the universal grid of things?
Well, don't despair, just twenty years immersed in molecules will do the trick.
You're a bit too busy for that? Well, tour the sub-sea bio-sites all over the web
and look, your colonnades of chemicals turn into an animal much older than man,
a skin, a skein of pores that sieves and chews bacteria like you and I chew bread,
a Henry Moore-like statue, all rounded, organic and organised around its holes.

No? Do the cyclic adenosine monophosphate ions in the sponge leave you dazed?
Do Taj Mahals of ectoderm, endoderm, gastrula and blastopore mean not a bean?
Does your philosophy foreclose on the individuality of each molecule in the air,
each cell in the sea, each atom of hydrogen in the fusion plants of a billion stars,
aghast to concede even the temperate uniqueness, the quietly differentiated lives
of the pinacocytes, amoebocytes and choanocytes that sit in grove after grove
like Quakers at prayer-meetings, polite and silent, across the bottom of the sea?

Then scratch below the wiggling flagella and see the bone-ware of the sponge,
no skeleton as it were, to rib and spine a ravenous filter battered by the tides,
but multiplicities of micro-bones, designed and purpose-built by cells on site
like bio-trusses, sail-stiffeners, an immanence of scaffolding upholding a life.

No? You could go Greek of course, all Græco-Latin and precisely precise,
and eyeing such bonelets, bright-lit in the jeweller's cabinet of a microscope,
could scorn the humanistic thought that some resembled asterisks in three-d,
that others looked like a dandelion, a spillikin, a model of a tetrahedral bond
and say, "Well look at that spicule! What a fine specimen of a siliceous spike
with granolithic, pre-Cambrian spiny hexactines that is, wouldn't you agree?"

Variety and pattern then, deep down the linked labyrinths of each living thing, each sponge, each atom a multiplex in fact, a Prometheus unbound by science, a metamorphosis in waiting, like animals and gods in Ovid's fluidity of mind, an algorithm at work within a live internet, an Omega, an Alpha-point of signs.

Sign-words like these - unspiralling from some primordial reptilian squawk, evolving with each biome of earth, finessing with the fingers and the brain and aeon after aeon becoming more numbered, more nuzzling, more detached, extruding a site-specific noun and verb, a syntax like the cytoskeleton of a cell, unfolding from an ancient, a still originating logos more inscapes of belief, more figures of speech, more formulae and equations and lexicons of science incarnating thus a consciousness, a cornucopian consciousness in space-time whose blood-flow's the metaphors of life that matter which is minded makes.

What marvels they are, embodying the metamorphoses of mass we perceive, mutations as dazzling, as sudden and domestic and temporarily disconcerting as that smash-out of photons, that fierce white explosion in a microwave oven which flashes into sight when a spoon, a modestly ordinary mild-steel spoon is left by mistake on the floodlit ceramic saucer of, say, a flowered cup of tea.

What happens next, when the fairground carousel of glass begins to turn?

That calm and shiny scooper of sweetness, that stirrer of a steaming brew as happily innocent of cathode and current, electrostatics and electron flows as guests who sit at the kitchen table, sleepily ingesting their muesli and milk, revolves through something invisibly vigorous, a wind of pulsating waves, a hail of atom-agitating particles till Bang! smoke, lights, Damascus time -

it touches the wall of a hearth where Prometheus Electrified has hid his fire.

Think too of mutations as numinous as a single stream of bright white light which pressing through a prism in the Attic amphitheatre of a lecture hall splays out into bands of colour, into shimmering pillars of purple and blue, rich yellow, orange and red on the starkly blank rectangular sky of a screen.

Who hasn't marvelled at such a revelation, not of the whole, of course, for all of us live, to modulate the metaphor, inside the pit of an orchestra, inside as it were an unheard suite of roaring, tinkling, booming resonance and stumbling round the instruments, from dim-lit music-stand to stand, are only vaguely aware that some enormous music is shuddering the air.

We glimpse at times a bass or treble clef, feel round the piano's lifted lid and floundering past the feet of cellists, the throb-wood of a double-bass, end up, let's say, among the crashing of cymbals, the rumbling of drums, then looking out, across the rows of heads, towards the back-lit galleries, the chandeliers, the dusty blue and gilt brocade that domes the auditorium we sigh and say, 'How peaceful is the night! And how serene the stars!'

No, no, never a revelation of the whole, not even of the smallest particle, the humblest sponge, the minimalist music of whistlers in the ionosphere. There are at best the brief illuminations we live by, the micro-Eucharists that feed our endless hunger for significance yet leave us hungering for more, for more eureka's that flicker, move off and fade, like a storm far out at sea.

But take that moment in a lecture hall, when luminescent on the screen
the columns of blue, of green and red electrified an immediate amazement
as if in every glimmer and gleam of light we absorb, from birth to death,
there waits a hidden colonnade, an immanent portico that opens out into
the huge divinity of energy which everywhere sustains the universe we see.

That moment, I'd say, was a close communion of science and consciousness,
a coalescence of body, mind and light whose mediating, ministering material
resembled the strands, the blobules of colour that painters squeeze from tubes
whose grids of electrons splatter sieved photons deep into the mind's dark orb.

How deeply bewildering, how redemptive it is to sense that art has evolved,
the handiwork of a gene-line that also crafts money, missiles and medicines.
Think only of the shouts of glee, the exultant bedlam that erupts after break
when punnets of paint are found on the drab linoleum of a pre-school floor.

What wonders they are, those silt-luscious lakes of bright titanium yellow,
perylene maroon, purple madder, oxide of chromium and manganese blue,
that mud-bath of umber, that dip-tank of ultramarine where boys in shorts
are pondering the absorption spectrum of tearful Susanna's bedraggled bear?

Imagine the teacher, dressed in jeans, a dark blue apron smudged with paint,
who stands with her back to a trough-like sink piled with brushes and jars
and sighs, with a weary contentment, at the sight of her babbling creative kids
bent over the colours, as if in a trance, as she wipes off her hands with a rag

the inky black smears from the tabloids cut up and scattered across the floor.

Look! Child after child, a sleeve pulled up, an elbow raised, a wrist bent back deliciously pats and wiggles a hand in a pigment's wet meniscus of molecules then lifts the palm and lovingly, drippingly squishes the mark of the rainbow on headline after headline of human folly and disgrace, chortling with delight.

Do we love art and science, the pattern-prints, the artefacts of significance because the apes and anthropoids of Africa, still gallivanting in our genes, sniffed and fingered roots and fruits and communed with the hues of dawn?

Did the drive to survive, the demiurge to thrive in each small moated cell nudge out more strings of neurons in the brain, more internets of synapses, more sensitivities of sight and smell, more lightning flashes of cognition, more ways of foraging for bulbs, roasting an antelope and raising a child, more modes of telling a story, coupling with a mate and trancing a dance, unfolding in fact imagination more quickly than the empathy of the brain?

Who knows, who knows, but consciousness the liberator is also the beast deep in whose biomes of cerebral cells the reptile glowers, lashing its tail, and imagination, so creative, so much the astonishing Mozart of the mind, imagination, when disconnected, from fuller circuitries of psyche and time sends spurts of envy burning through the cortex, or coolly plans a Somme.

No wonder we turn to art, to science, to quests for redemption and grace to stay one tool, one song, one prayer ahead of the holocausts we embody,

hustled by the ions of curiosity that make us keep leaving the known behind.

I mean why did the sensors in each eye, the bundled threads of their nerves,
the thought-flickers of the mind unfocus the other imagos that filled that hall,
the fire-extinguisher, let's say, all cheerfully red and competent beside a door,
the Exit signs, the rows of youthful heads, the heart inked on my desk in blue,
the dust motes that floated tumbling and twinkling through a stream of light?

Enigmas these, enigmas whose full intermingled complexities elude the mind,
each one a Gordian-knot nexus of the very old, the very distant with the new,
each molecule a delicate commingling of cosmic gravity with the very small,
in kinships as improbable as the sun with the chlorophyll of a sprig of mint,
the impersonality of electro-magnetism with the individuating urge of an ant.

Inseparable in fact, these kinships, and billions and billions of offspring old,
yet ruptured in the leafy habitat of Eden, the bonding biosphere of the One
in the very act of saying, Look, look, that stalk of wheat is green with grain!
and further undone, their resonance of electro-magnetic forces ripped open,
their web-strands of consilience dangling, with each rough act of winnowing,
each new experiment in a lab, each table and graph, each tentative hypothesis,
each micro-biologist's report, each agro-business estimate of revenue per ton
till the harvest of science from a grain of wheat ruptures the silos in the mind.

Perhaps that's true, more terrifyingly true than the brave porosities of a self,
the valiant psyche of that allergy-skinned assemblage of sensitivities the soul

can even begin to contemplate, lest we become a wild-eyed, tormented Lear who lurches through the mist and rain, his sweet, sweet sanity gone for ever.

Gone like a heap of stones, where once the motley troubadour sang in a hall, the horses pranced in the stable-yard and pure white swans paddled the moat, gone like a library in flames, its book-stacks toppling in a migraine of thoughts that come so thick and fast, in such huge gusts, they send the roof-tiles flying and howl through the burning galleries till charred black beam and cornice fall and smoulder and hiss, chaotic in heaps, in the cold grey oblivion of the rain.

Well, staggering about like a dataholic, bingeing on megabytes of facts or not, what scholars who research a new disease, an aphid destroying acres of wheat, the short-wave radiation of a neutron star, a proton-pump in the skin of a cell, the molecules of carbon in the troposphere, the water in an emptying aquifer, what scientist has ever predicted a terminus to discovery, a closure to science?

And even a latter-day polymath, an Einstein who tunnels for years and years in and below the great Amazonian forests of physics, biology and chemistry, like a mole, a torch on his forehead, in search of an explanation for everything, even whiz kids like him, the moment he'd merged the sciences into one maths would immediately have to emerge and scratch through new work on the web then fiddle and twiddle with the constants, the formulae he found all over again, such is the mutability, the flux of paradigms, the time-flowed findings of science. Was Newton a mystic when he said the scientist stands on the edge of a sea?

But hang on, Herr Doctor Polymath Professor, what human can ever hope

to leap right out of his ancestry, right out of the flesh and blood of the brain
and leaving the flare-paths of neurons, the flickering synapses far behind
go walk-about in the terra incognita that is not time, or space, or mind?

Thought's boundaries are real, for Gödel discerned a limit to maths
and proved, quite modestly, that any arithmetic is always incomplete.
And Bohr announced, surfacing like an Orpheus from a micro-world
that unpredictability was predictable everywhere inside the nucleus.
And Planck mapped out a parallel world of what is smaller than small,
those tiniest of tiny time-spans and energy-amps and spaces in space
where minuscule matrices of forces grip neurons with massive finesse,
a cosmos where human touch is coarse and quantum caprice the rule,
whose honeycomb in miniature is the substrate of all our eyes perceive
and ten to the power of minus something baffling and bewildering in size.

And Heisenberg, who considered his physics a liturgy, a walk of faith
established a shocking incertitude, not grounded on wild superstition
but based on a mathematical model of the granular energy he probed.
Atoms and electrons from far, he said, were patterns of probabilities,
but viewed up close, their patterns dissolved in a blur of random events
as motes of energy, as messenger particles fuzzed in and out of mass.

Fleas in a box? Star-spangled acrobats in a circus-tent thick with fog
who tumble from rung to invisible rung? Well, hardly, Mr Heisenberg,
but no one who's tried to chase an electron speeding around a nucleus
or pinpoint a separable event in the vacuoles, the chasms of nano-space
would probably disagree that it's easier to catch the wind in the hand

than isolate the mass, the speed and position of one sub-nuclear speck
in one split second of the flutter and flow of energy's miniscule fields.

Worse for militant rigidities of mind, for fundamentalists allergic to fuzz
attempting to do a Procrustes on science [{by trimming physics and chem }

{ by pruning biology, zoology, hydrology, aerology, mycology & ecology }

{ by slimming botany and agronomy, astronomy, cosmogony and maths }

{ till all of science lay neatly if narrowly in rack after rack of wooden bunk-beds in the mind }]

would change a bus-load of chattering backpackers into a morgue of stiff.

Imagine the mayhem, the massacre of subtlety, complexity, hypothesis,
were most of geology and geomorphology, palaeontology and ichthyology
as well as the megabytes of physiology, of pathology and neuropathology
of pharmacology and gastroenterology and gynaecology and gerontology
mashed into that government hotel for ideologues, goons and party hacks,
that hospice for reductionists, The Ology of Ologies to End all Ologies.

Take one domain, just one, and squelch, as it were, across the sedges
that fringe the mudflats of a wide brown river as the tide slithers back,
with a spade in one hand, a sack in the other and a truck on the bank

Let's say you're determined to extract, to enshrine in a city's aquarium
a sampling of the fauna and flora alive in the Canaan of that river mouth,
to bring right home to the shoals of school-kids, the teachers and tourists
the mothers with toddlers in tow, the straggle of name-tagged delegates
traipsing in with cameras from a conference on global shipping or trade

how utterly sacred is the interdependence of soil, water and plants for life
how vulnerable is the estuary to the blue-green asphyxia of a shroud of oil,
the seahorse in the reeds to phosphates that mucous its rose-window gills.

Dream on, diligent digger, if we are as I think we anxious earthlings are,
epiphanies of dust, begotten and evolved when this small planet of ours
was battered by flights of asteroids and swaddled in a cloud of steam,
epiphanies of impersonal nuclei, sub-nuclear storms, electrons, quarks
which billions of years before were fused and fissioned from burning gas
inside the kiln of a long-vanished star, which incarnate a miracle now,
the skill of a helix to spin off a gene, the drive of each cell to survive.

Dig on, dreamer, dig into the slush of your estuary and help us revere
what those first morsels of life morphed into, the millions of prawns,
the bloodworms and molluscs below the mud, the crackle-backed crab
scuttling through sedge-grass with the offering of a shrimp in its claw,
the algae, the clams, the worms in wells that suck and whoosh for hours,
the cormorant on a rock, its wings held open like a black umbrella to dry.

And hovering, hovering its blue-green lapis lazuli glitter above the reeds
that sudden kingfisher up in the air again, hungering like the imagination
for the energy of a food, for significance stored in the murk of its habitat.
The wing-whirr lifts, eyeing the water-smudged, silver-pale slivers below
which dart and drift, this way and that, in the wind-rumpled eddying tide,
then hovers forward, drops its beak, slaps shut its plumage and plummets
down, down, down - till it crashes its fleck-blur into the flesh of a gleam.

Note that, naturalist, as well as the rusty old tin, the oil-slick in the reeds, the fumes of a diesel-fed tractor that wafts across a wetland on the wind, and marvel how fluidly this feathered macromolecule of sugars and fats, of proteins and nucleotides infuses fresh oxygen in the throb of its blood, then let me ask why, why it is that the more you make us conscious of life, the multiple dimensions of life in a river-mouth, the more there is to learn.

Think only of the crowds of copepods, tiny crustaceans with antennae, a spiky swizzle-stick of a tail, nibbling soft residues that granule the silt as they wriggle and drift, squiggle and glide through the flow of the tide, a thousand to a bucket and each the workplace of a billion diligent cells, each one the locus, the life-site of a fierce, autonomous telos to survive where quantum creativity pops out, in generation after gene generation, that quirk of a creature better adapted to a change in the weather or grub.

Imagine a hundred researchers, sloshing this way and that in the estuary, in shorts and wide-brimmed hats, with scoop-nets, clip-boards and jars, all trying to understand more of copepod life, by measuring their feelers, counting their offspring and trying to locate where and when they breed.

Envisage next an insect sociologist, a curiosity made more curious still by years and years of research, an émigré intellect, a Prospero of science, who seated in a curtained caravan, parked in the bushes on the river bank, peers into a matt-black microscope and twiddling a pair of virtual pliers glues onto the crab-coloured, louse-speckled armour of a copepod's back a video-camera and a radio transmitter, each smaller than the tip of a pin.

What would our visionary see, when seated in front of his caravan desk with wired-up copepod back in the river, browsing the silt once more, he taps the radio receiver's keys, intent on focussing a copepod movie from blurry cloudscapes of pixels that jiggle all over his monitor screen, yearning to glide like a Zheng He across a habitat not journeyed before by riding the back of that digitized goblin, that high-tech estuarine elf?

What brave new worlds, each whispering a poetry never heard before would slowly float their spectral silhouettes towards him on the screen, silhouettes of minuscule islands, forested by fungi whose hills are green with gardens of lavish bacteria and symmetrical shrubberies of mould. "Focus, focus!" you shout in alarm as dead ahead, suspended in the sky, the gel of water molecules, a sand-grain bigger than an asteroid looms.

The camera-elf dives, a shoal of diatoms glints through a cloudy gloom, the rock slides overhead, and then look, look, top right, another copepod is nudging close, a clutch of shrink-wrapped eggs held in her swimmerets. Trr-teek. "Sssh! What's Goblin saying?" you ask. "Why here? Why now?" Trr-teeka-teek. The speak-head wiggles and shoots away, but not before you know you've peeped into a cranny more creatured and crafted by life, more individuated, more complex than you can ever hope to apprehend.

Finality in knowledge, the safety of an endpoint, the security of a fact, weren't these desired in the craving of our nomad forebears for a cave? A cave that's safe from the slobbering hyena that stalks upwind at night,

from running men with fat-smearing chests who hand-axe foes to death?
A kinship womb, a trance-dance shrine where painted on rough quartz
a white-and-ochre eland leaps high above a posse of hunters with spears?
A kindergarten, so to speak, where cave-kids handcraft hippos from clay
and stare at night across the fire at shadows that squiggle across a wall?

But lairs like these, while safer than the lion-stalked grassy plains below
have paths through bush towards their openings that enemies soon climb,
are home to quarrels, to lungs that fester as well as lullabies and chants,
have scuttling bugs and oozing slugs and things that nip the softer parts.

How long in fact, could people born in hospitals enjoy the fine perfume
of skins pegged out to dry across the floor, the steady, generous shower
of nutrients from a ceiling that twitters with eco-heavenly choirs of bats,
the dimpled toddler's puddled ponds, the talismans of monkey brains
hung on a strand across the cave and little mounds, bejewelled by flies
that mulch the mountain slopes, the Eden groves of mothering Africa?

And troubling, much more troubling for fine philosophies of perfect forms
where Beauty, Truth and Wisdom shine on and on through all eternity
and life is but a shadow-land, a transience of error, suffering and greed,
the branches burning in the hearth flare up in draughts, then fade away,
the dusty rays of light that deeply stream into the cave at dawn and dusk
lift up and drop and swing across the mouth as earth spins round and tilts
as if that source of truth, the light, kept changing in the whirling of the One.

And seated on a skin, or moving back and forth across the rind-strewn sand

and going out and coming in again, the animals out shadow who they are, a frieze of changing silhouettes, a blurred and silent film in black-and-white where psyches loom then shrink away, from giant-to-chimpanzee-to-gnome, where skulls one day are skinny Giacomettis, then chubby Boteros the next as if irregular regularity, and movement, and change was life's abiding truth.

Do I exaggerate? No noble Plato, not at all. Think only of astronomy's flux, the hash-marks, the arrows that spluttered from the nibs of stylus and quill on the astro-maps of Egypt, of China, Mesopotamia and Arabia and Greece. The splutters are the thought-logs, the mind-maps of watchers and thinkers who made immaculate sense of the data by inferring that the sun and moon, the stars and planets and all the heavens turned round and round the earth.

Theirs was impeccable science. They mulled into existence in the mind an explanatory principle, a logical illusion derived by reason from maths. And we who stroke in our consciousness the idea that we've improved, are more intelligent than they, more sussed and in charge of our selves than the generations of Homo sapiens sapiens that trekked out of Africa, we do well to remember that even an Einstein blundered into the new.

The universe was fixed, was staid and steady as a barn of stars he assumed when first he conjectured that light-speed, energy and mass were linked. To clamp the sprawl of the whole equation together, he added a constant, a symbol, a potency which much like the cog of a governor in a gear-box ensured that the cylinder-head gasket of the giant machine did not explode. Persuaded, years on, by news of the red-shifted light from a speeding star

he relented at last and rubbed off a blackboard with the back of his sleeve
a chalk-mark, a lambda that held the whole universe together in his mind.

Think too of how the crystal spheres, the wandering planets left the board,
with Dalton's dots, Darwin's gemmules and Lamarck's long-necked giraffes.
And think of the whiskered physician, so learned beside a four-poster bed,
who'd bend and venepuncture a pallid patient's blood and vapours away.

Think too of the friends of phlogiston, the foes of Gondwanaland and aids,
the skilled phrenologist assessing a psyche by feeling the bumps on a skull,
the alchemists and eugenicists, the intelligent patrons of the Piltdown man
the big-brained homunculi who lived curled up inside a droplet of sperm.

All wrong, all superseded by a subtler, broader understanding of life,
by constants and equations that better fitted a fuller assembly of facts
like those amassed by Copernicus to reveal the ellipses of the planets,
by measurements and discoveries in one domain, which used in another
illuminate a lunette in reality not glimpsed in the consciousness till then.

I'm thinking of a scientist who'd studied the songs of whales for years,
who ambling past the elephants in a zoo, perceived a rippling in the air
that shuddered and went, remembered the bass vibrato she'd registered
when near a great organ in a church, a rumble she felt more than heard,
and suddenly realised that the great grey herbivores of bush and plain
communicated like whales in wave-lengths too long for humans to hear.

I'm thinking as well of the small grey sensitivities constructed by science
and moored on the seabed to spy on the slide-by traffic of submarines.
Re-jigged by geologists, to map the electro-magnetic fields of the earth,
these cochleas of metal confirmed what scientists had mooted for years,
that aeons and aeons ago the cloud-swirled continents we know today
were joined together in one enormous land-mass protruding from the sea.

I'm thinking not only of the flush and fade of new ideas in the mind,
but moments of sudden illumination, those moments of no going back
as when an ancestor of the species first uttered a bead-string of words,
kindled a fire, chipped out a hand-axe or charcoaled a deity in a cave.

Embedded in a changing biosphere, made restless by quantum caprice,
chattering, scrapping and playing in scurrying groups of flea-picking kin
and endlessly monkeying about with things picked up on the forest floor
our consciousness became more imaginative, more complex with time,
a cosmic time that is itself a bursting out of energy into mass and mind.

I mean just imagine the mind-burst when a puzzled Sumerian priest,
having dampened the tablet of clay in his hand, sharpened his stylus
and slowly figured, in space as it were, a bird-headed god and a tree,
then turned the pen over, dabbed down the rough O of its other end
and pondered on the temple porch, Could this small moon stand for a ten?

Or when a scholar in Babylon, impatient with the bulkiness of clay,

the clumsiness of pictographs that couldn't depict the flow of talk,
spread out a fibre-thewed sheet of pulped papyrus across the floor,
dipped the nib-tip of a whittled feather into egg-yolk and charcoal dust
and mouth open, straining to separate and say each syllable out loud
like a five year old youngster learning to spell, scratched onto that rag
the spindly, leaky-edged letters of the first ever word written down.
What an epiphany that was, what a prising open of reality still occurs
when thoughts transformed by the hand enter the meta-world of a text,
whose symbols encrypt a potential energy, a transcending significance
that flicker like lightning in the mind of the reader in the lingui-sphere.

Axes and ploughs, numbers and words and subtler artefacts of thought,
the matrices of enlargement, like Maxwell's forces, Newton's calculus
the cells of Schleiden and Bohr's mathematics of the quantum domain,
all potencies of perception as much as the hieroglyphs of ink on a page.

How eerie, how astonishing to think that the bio-chemistry of an ant
can live beside the physics of the stars in the brain-cells of the mind.
The mind's that absorbent, a passive activity and an active passivity,
inseparable from the node of timed-space energy in which we breathe
and born to fiddle, like Faraday, with bits of wire, magnets and dials,
desirous of meaning as well as facts, prone to belittle the great unknown
and restlessly lunging from one nebulosity of knowledge to the next.

At times a wandering jellyfish, a blob that floats far out in the deep,
a domed medusa, with tentacles dangling, which wallows and drifts

as swell after swell, squeeze after slow-moving squeeze of gravity
keeps swilling its rubbery cerebrum with washes of a nutrient sea.

At other times the mind stays home, a priest, a philosopher in residence,
a little low bush, rounded, resilient and restless in the winds of a dune,
and older than land-life, ancestral in its austerity of function and form,
that headless progenitor of ours, that grit-spitting blob waving its arms.

Salaams beige Polyp, begot of a protozoa deep in the womb-wet of the sea!
All hail, shy seed of the seed of my seed! My Mater-and-Pater-All-in-One!
Begetter of all the begetters that begat and begat until they begat my begetter!

How ridiculous and marvellous, plucky and lugubrious an umbilicus you are,
standing there, standing up straight, month after month, in tides like gales.
You are, I guess, the peasant Grandma, the hag the kids are so ashamed of,
a stumpy old has-been, a hairdo gone Bonsai, the antonym of hip and cool.

But hey, Forebear, that protein-splitting enzyme you fashioned in your cells
that mega-invention in miniature unfurled, am I right, a few short eons on,
each voltage-gate in each meniscus of me, and then each thought and word.

So what if some of your descendants, the thump-drunk punks with tattoos,
the glamour-mad TV-clones with rings on their fingers and studs in their nose
say Yuk! when some daft teacher in tweeds extols your chemistry in class?
So what if to such you're about as beautiful as a tea-bag at the bottom of a bin,

to me, polymorphic and unpoemed polyp, your chemistry's much more electric,
your sexuality more potent than the sultriest celebrity pouting behind a mike
for you're what it took the charismatic cosmos billions of years to bring into life.

But look what the splodges of sea-sifting sessiles have polymorphed into now,
I mean descendants as motile as midges, spin-dancing in clouds above a stream,
as labile and solitary as anxious aardvarks trotting across a savannah at dawn,
as gracile and languid as a shade-dappled cheetah somnolent below a fever-tree,
as flocculent, cacophonous, yellow and purple as cockatoos flashing their wings.

For minds one moment are pots of stew, steaming with culture's marrow-bones,
the meat, potatoes and onions of facts and memory, the garlic aroma of faith.
The next they're compressed, the slim proboscis of a dragonfly sipping a pond
which stores in each siplet an ark, a huge menagerie of animated animalcules,
and smaller still, a beam, a stream, a traffic of electrons that sonar a grain of sand
and bring to mind crystalline tiles like mosaics in miniature mosques and St Marks'.

Small wonder then that the history of science is the history of human explorers
who keep on changing their mind about the nature of nature as well as the mind,
a history, let's say, of theories that flourish then fall, of paradigms that fade away,
a flux-field that asks us never to foreclose on the fact that we are probably wrong,
on the certainty that beyond the algorithm waits something completely unforeseen.
In that humility, that readiness to ponder afresh, the vigour of science is bred.

For science is not the pure, immaculate conception of a mathematics,
a galvanised lattice-work of verities, awaiting discovery in outer space
or even a theme-park museum of ideas, whose geodesic dome of glass
glimmering with lights above the smoggy miasma of human ignorance
entices us to murmur, 'Look no further, this is reality, this is the truth.'

There is, I suppose, a beguiling optimism to such a vision of science,
an optimism which some might regard as innocent and others naive,
as if a quick-fingered, inquisitive hunter-gatherer, a few seconds on,
in cosmic time, from tubers and berries and huddling at night up trees
could chew the roots and swing on the monkey ropes of all the universe.

A root, a branch, a bushveld outside the mind, yet also magnificently within.
For bird-song in the bush, the stench of carrion, the photons from the sun
both stream past our heads and pour right into the portals of our perception.

What a transubstantiation then occurs! For sound and light and scent
then change, change subtly, silently and irreversibly into consciousness,
into quivers of electricity shivering this way and that across the brain,
a lightning squall that's then transmogrified, into thoughts and words,
into brief verisimilitudes of what really is, into Look, a bush on fire!
into continua with different quanta of complexity, that flare into images,
into models of reality, hints and clues that never ever can hold the whole
but incarnate as much of the whole as makes a painting comprehensible,
as thoughts cloud up and disaggregate in the memory matrix of the brain.

Consider Monet, bearded, be-smocked, standing in a field of poppies,
his canvas on an easel in front of him, his palette and brush in hand.
A child with a handful of poppies, a woman with a hat and parasol
are wading through the grass of the field, but as we observe the two
he drops his gaze from the clouds, the tree-line at the end of the field
and paints on the canvas, a little above an off-white oblong in the trees
a roughly square intaglio of terracotta. Aha! says the mind, a roof!

The top of the roof smears off into cloud, the brush-stroke left visible,
as if incompleteness of expression, the acceptance of incompleteness
was human and natural when trying to envisage a farmhouse in a field.

The poppies too, in exuberant splodge after splotch of poppy-red paint
are illusions of the flower, real illusions, not mere disjunctured fantasies
of what the child holds tight in a hand, what memory names as a flower.

Beyond the palette in Monet's hand, beyond the focal length of his oils
are the whiskery tips of grass blades too intricate, too numerous to paint,
the smell of soil, the croak of a glossy black crow that flaps down the road,
the colicky anxiety he feels in his gut about the unpaid accounts on his desk,
the memory, as it were, of a sunset in the stone-quay harbour at Le Havre
when first he abandoned his brushes and painted light with a palette knife.

All hovering in his consciousness, like an energised time-space in flux,
and all omitted from the space-frame of the canvas to create an illusion
which scientists might call a figure, an incomplete model of the whole

and artists a landscape whose colours and tranquillity beautify the mind.

Einstein, I like to imagine, experienced a similar ensemble of felt ideas, a similar coming and going of niggles and hopes, irritations and fears, amusements, filial concerns, stirrings in the loins as well as the bowels the night he modelled the universe in his humble apartment in Berne.

I see him now, in shirt-sleeves and braces as he leans across a table-top chaotic with unfinished bowls of soup, an infant's toys, science journals and books by Maxwell and Hertz, the boredom with his job postponed, a messy idea that light was particulate coming and going in his mind, as he answers a question from his wife, wipes his mouth with a napkin, rocks with one hand the wicker-hooded basket that cradles their infant then starts to write with the other the words of a paper, five pages long.

Five pages of numbers and words, that's all, an array of hieroglyphs that stand for patterns in the cosmos more complex than themselves, like Monet's dabs of paint, like pictographs on a tablet of clay in Ur, like ethics intoned by Mohammed or chiselled by Moses into a stone, like ziggurat and monolith, altar and shrine and the Taj Mahals to love that human spirituality transmutes into meaning from the stones of earth.

A spirituality embodied in the genes, in the chemistry of consciousness, a yearning for meaning, an urge to belong, to understand and to improve as visceral as the telos to survive, to replicate that throbs each tiny cell.

A spirituality that filters the phenomena received and mixed in the mind,
that fuses them into artefacts of interpretation, transcendent of the self,
each artefact explanatory of a domain, a complexity larger than itself,
each incomplete and complete as a creed, a painting of a field in France,
a book that calls itself an introduction to the bio-chemistry of the brain.

These are the holons of understanding, the force-fields of interpretation
that help us make sense of the flick-past phenomena we live in each day,
that fuse together images, thoughts and emotions from past experience
and flicker them through the mind, displaying as it were a documentary,
a history channel of significant events observed by a watcher on a couch.

These holons are the granules of our identity, of feelings and significance,
and come and go in our consciousness as naturally as an animal breathes.
Their sudden flares of micro-volts, blazing through a network of nerves,
embody meaning after meaning in the blood-fed flesh-lobes of the brain.
Again and again and again, they shimmer their esemplastic metaphors
in silent explosions of lightning through the cumulus clouds of the mind.

The more coherent and figurative, the fuller and more inter-energised
the shimmers of these holons become, by means perhaps of meditation
and the integrating electricity of prayer, the less disjunctured is thought,
the more comprehensive and connected the force-fields within the mind
and, who knows, the more serene and wise, the more humane the animal.

Holons cohere in assemblages of memories, a tree here, umbrellas there,
which flit in and out of view, while the photons of a tallish, raggedy tree,
of the hints of a broly beside a sort of head this side of a kind of horizon
keep spattering pointillist packets of energy into the retinas of the viewer
who stands, let us say, in a book-shop, a painting by Monet open on a page.

Next comes an act of recognition, performed by a force-field on a couch,
which matches the holon with the data and prompts the psyche to exclaim,
I've got it, got it! That scratch and a zero means ten, the ten of everything!
Or, How poignant that looks, a mother in a field of red poppies in France,
Or, Wait, family, I've just discovered that energy, mass and time are one.

How intimate then, is mind, energy and time, how delicately, eerily intimate
is the thought of a star as well as the tiny photons that shoot from its mantle
and having tunnelled through the cosmos for millions and millions of years
splash silently into the retina of a child looking up through the bush at night.

This intimacy is unasked for, is the force-field habitat of our being on earth,
is as loving, as tender, chastening and firm as a mother's embrace of a child
is as fresh and new each second of the day as the air breathed into each lung,
and old as the hunger of each animal's enzymes for minuscule snacks of zinc,
for tiny helpings of cobalt, nickel and selenium, not freely dished up on land
that feasted our ravenous ancestor cells inside their hot restaurant the sea.

This intimacy is native to energy, to time that's matter and mass in drag,
to earth where cosmic dust becomes aware, where cortices, as it were

create home videos out of the insensate minerals of carbon-coiled life
and streaming the pixels and pigments together, picture in silhouettes
how photons of sunlight meta-morph into oxygen in the foliage of earth
and hydrogen, in the heat-crush of a star, cracks out into helium clouds.

Hydrogen and helium, sunlight and oxygen, the brain-cells and the mind -
all intimacies that amaze us, along with the inseparable interdependencies
of predator and prey, of creature after energy-craving creature in webs,
in latticed webs of life-giving death that leave us bewildered and appalled.

Consider as well the fizz, the consilience of forces that simmer all around
our brains and blood, unnoticed except by the aerals of our instruments.
I'm thinking of the bulleting specks of neutrinos, emitted by a super-nova
millions and millions of light-years away, that shoot right through a skull,
the pale blue light that the bees perceive, the gradients in magnetic skies
that navigate a bird migrating home through gale-torn mist above dark seas
the fluid adhesive of the gravity that stops a hat from floating off into space.

I'm meaning as well, as best as words can, the enormous invisible energy
that hugs the invisibly tiny universe of the nucleus and electron together
and the Babel in the biosphere of television, telephone and radio waves.

Too much, much too much energy for the brain of the species to absorb
to sort into patterns and turn into sense, too noisy and messy and blurred
and so chaotic, so violent and vicious when human animals claw and fight

that missionaries of science, the humble scholars of algebra and astronomy suggest that Homo ferox should phase out into a life of clear and cool ideas, a calm Nirvana of symmetry and predictability, progress and enlightenment in which the reason-adoring multitudes of science-minded people can dwell.

Science is more human, more fickle than that. Science is made by people with different fads and fancies, who follow intuitions and tussle for power. Science is the result of accident as well as the product of a budget and plan, accidents as unpredictable as a puff of penicillin spores landing on a plate. the sway of a chain-hung lamp in a church, the clonk of an apple on a head.

Science is shaped by decisions in committees, jealousy among colleagues, by the funding policies of nation states, the politics of university faculties, the budget of the pharmaceutical corporate, the race to get to the moon.

Science in fact works like a coral, a wetland of data full of rot and reeds, a huge, untidy, smouldering compost-heap of new and discarded ideas, a fusion plant of theories that nutrient our understanding of the universe, a phase-space in which the arts and faith can induce new images and words in both the micro-cosmos of the particle as well as that small planetarium the macro-space through which this spinning planet sails its crowded ark.

When I was still a boy there was a comforting security in the skies. They seemed by day a pale blue canopy beyond the turbulent clouds, by night a tranquil, stationary dome shimmering with peaceful stars which had the beauty, the poignance of that painted room in Rome

above the terracotta pots of red azaleas clustered on the Spanish Steps
where Keats, beloved, generous, suffering Keats had coughed his last,
looking up, I knew, at the white starry splashes on the ceiling's blue.

I'd think of him at times when back at home, a student in South Africa,
I'd run barefoot along a ghostly curve of beach at night and looking out
above the sand-soddening, foam-frothed surges through which I splashed
and over the thump, the brief silence then raucous roar of a breaking wave
I'd see the sprinkle of the Milky Way far, far out above the sea's dark rim.

It seemed serene, beyond the turmoil of the rock-edged beach I ran along,
a silent spatter of roughly patterned light, an arch which curved high up
and over both the secrets of the ocean and the turbulence of the continent
and brought to life within my consciousness emotions I hadn't felt before,
strange swirls of excitement, happiness and longing I couldn't yet identify
as if it formed the doorway to the grass-domed home of Nkosazana yezulu,
the Zulu Princess of the Skies, the beaded Ceres, the Sarasvati of that shore.

What hopes of bliss, of sumptuous fertility, of politics freed from prejudice
danced in the flickering light around the thorn-wood crackling in her hearth,
as if the smiles that flashed from face to face, the murmur of a drowsy child
wrapped in a blanket on her mother's back, the spiral of the choric harmonies,
the laughter of the clan who danced as one around her dung and beeswax floor
made manifest an urge, a metabiology engendered by the structure of the skies.

That doorway's arch of stars at night, its rainbow's evanescent gleam by day
were metaphors that housed the revelations of the red-robed prophet-priests

who prayed beside the streams adorned with white and ochre washes of clay and straddled the mind-leap of saintly Ntsikana's hymn to a single Power, as if domestic myth and science were analogues of each other's divinations.

They roofed a lexicon, a poetry, a liturgy of work-songs, dirges and prayers which roused long dormant emotions in the mindscape of even one like me whose kin had moved from farm to town at least three generations before - abundant corn and dark green spinaches, moon-plump pumpkins and meat, the scent of milk in wooden pails, the pungent incense of the small grey herb which burning cleansed within the memory the malice of a forebear's shade.

The oratory, the orisons of the praise-poets in the hills embodied even more, the heroes, the sires of a heavenly age that hadn't been nor ever would exist yet shimmered in the morning mist that softly glimmers on the local estuaries like phantoms of a better future, always just in sight but never quite in reach.

So what if sunlight thinned the mist and mud-flats, gulls and trash appeared and with them, let's say, thousands of shacks packed round a city's periphery like countless human testimonies to rural desperation, resilience and hope, a carbon-black factory, spewing soot, and rumbling across the estuary bridge huge trucks of beef and tankers of milk hurrying towards the shopping malls? Defiance, I'd come to understand, had always been part of poetry's repertoire.

Most nights the grandeur of that glittering induced in me a simpler exultation. The horn-tips of Taurus, high above a bushy dune, Orion's triple-studded belt, the slow ascension then fall, imperfectly observed, of constellations in the sky

had now become the open classroom of the minimalist science learnt at school where structured deep within the surface discontinuities of the wind-torn spray that sometimes flew into my face from off the raucous shatter of a dark wave, the whiffs of soggy kelp, the grey-white Arctic terns shrieking above the surf, there were eternal laws, quietly and precisely controlling all physical things.

Hour after hour, these shaped the universe that Newton's science revealed, a huge and heavenly fixity of space and time, which always had been there and always would exist, a kind of permanent barn of empty space and stars whose movements thought, mathematical thought, could gauge and analyse, producing with its subtle instruments of calculus and spherical trigonometry a corpus of abstractions that clarified and then predicted, with cosmic reach, the perturbations of each observable entity in the roomy chasm of the barn, even in fact the quick white streaks of light I'd glimpse at night above the sea.

Those elements of science emerged, of course, within the turmoil of a school, where after break a brave if only partially triumphant attempt to demonstrate harmonic motion by twanging the coils of a spring stretched out along a stoep gave way to the causes of the First World War, the mineral beds of Mongolia the disorderly conduct of an irregular verb and then, after a meeting at lunch, a couple of hours in a music room trying to find the Mozart in a maze of notes.

All this meant little, it must be said, when set beside such adolescent verities as being left out of a cricket team, unfolding a handwritten letter from a girl or fiddling at the back of the class with another catastrophic bump on a cheek which all the world seemed to be gawking at, promising more nights of gloom.

That science, like the Latin and history we learnt by list, was taught as facts, and facts, assimilated term after term, required obedience to adults and texts, and more than that, a subjugation, a sacrifice of present whims to higher ends for facts, saved up with hundreds of thousands of thinking skills in the brain, plain facts not only shaped the currency of values where job and car emerged, facts were the real reality of fallible humans and in their own way rather fine.

Thought-years away from such a school, how could a scrawny scrap of a boy who pulls at a wind-tattered plastic shopping-bag flapping on a strand of wire, who strolls, this very moment let's say, with a group of ragged-clothed friends among the motorcar packing-case alleyways of a shackland surrounding a town who frolics a while with a puppy that jumps up and licks the sores on his arms, how could the untaught mind of such a fatherless, motherless street-kid Lazarus cohere with the data, the subtle differentials in Dives the entrepreneur's brain whose guards patrol the boom-gated entrances to mansions, north and south?

No, facts were the shibboleths of success. Their Graeco-Arabic-Mandarin domains, when set against the staid continua of hunter-gatherer bands, of cosy village courts had generated something much more powerful, an analytic, centripetal force-field, a frequency of cogitations, an oscillating flux from observation and measurement to laws of motion and governance, to textbooks, internets, vaccines and submarines.

Out of trajectories of thought, of maths and science, medicine, economics and law, enormously large-scale impersonal arrangements of facts and formulae emerged whose lexicons a starved young Lazarus, playing with a puppy beside a shack, could never hope to embody in the dark abysmal poverty of the unloved mind.

One such trajectory, that of the science of Einstein, Heisenberg and Bohr burst open the size, the stability and simplicity of what I'd learnt as a boy and prompted a Shiva-like whirl of doubts and uncertainties in my mind, whirling and swirling me on and on from one new paradigm to the next as I struggled, for years, to find apt metaphors to art the new cosmology.

Don't think I exaggerate the entropy, or fool yourself that clouds of ideas which hurtle back and forth across the soft electrified nodes of the brain like miniature bouquets of facts in the fairy ring of a particle accelerator won't smash into new configurations and shatter open, if only for a flash, dimensions of the real which our deft human eyes can never hope to discern but seal up as a surface, a texture, a generalised blur in the very act of sight.

Take the static universe I thought I ran below along that raucous beach, that steady turning of the silent stars at night which our ancestral kin had stared and stared at for long millennia, from the steppes of Asia, the plains of Africa and the mud-brick yard of a Mesopotamian home.

Troubled by the careless malice of weather, the violent caprice of war, the malevolence of a despot, the septic sores of a terrifying new disease, who wouldn't be comforted to see the quiet predictable glimmer of stars revolve above the Sphinx, a flooded field of wheat beside the Nile?

The sky was a cave, a fixity, a permanent roof in the mind of the clan, whose stars to the San were handfuls of wood-ash thrown into the sky, whose constellations to Dante turned in the crystalline spheres of heaven and seethed in Shakespeare's cosmology as portents of evil, love and grace.

Hubble exploded all that. Hubble sat in the dome of an optical telescope and night after night, above the lights and traffic of the Californian coast collected the specks of light that had travelled from the hazes of nebulae and let their miniscule energies mark the film of atoms across his plates.

He worked, it seems to me, with the patience, the delicate artistic verve of painters who imaged out the gospel in monasteries in medieval times, who'd dip into their egg-shell pools of emerald, white and azure gouache and bending across the parchment would dot by dot build round a word a star, a sky, a cloud, a vine-in-leaf using a brush made from a single hair.

Like others Hubble thought nebulae were clouds of interstellar gas on fire and that beyond the Milky Way there burned no other plenitude of stars. He and Newton, and even Einstein perceived the cosmos as a fixed abode.

Science exploded all that. Hubble and astronomy extended in the mind the height and the depth of the universe, the logarithmic scale of its age and showed that far beyond the sprinkle of wood-ash thrown into the sky were cluster after cluster of stars, in spirals and swirls light-years in size.

Each cluster was a nexus of millions and millions and millions of stars which hurtled outwards from all the others in every direction he looked and backlit the stage of a parish dance, the frail frenzy of people on earth.

How did this new paradigm emerge? From night after night in a telescope whose mirror was bigger than those before, from money paid over to science, from images measured and analysed, from budgets, boring meetings and plans, from page after page of calculations, from hypotheses surmised then dropped, that's how this cosmos emerged, as a pattern, an irregular regularity in a mind.

If art took time to sip the grandeur, cosmology sprang quickly from the science. The cosmos became a plenum, a fullness, as Plato thought, a sphered coherence of electromagnetic forces, a fissive resin, a plasma shot through with neutrinos, all inseparable from what inadequate language dubbed as energy, mass and time.

Enormous vortices, whirling and swirling, gobbled up dust, gas and galaxies like midges sucked into the roaring whirlpools of the River Zambezi at night. They tore off the mantles of nearby stars like titans ripping wrapping off sweets while spurts of light, much bigger than the galaxy in which our earth revolved would briefly brighten an intergalactic dark then vanish like a firefly out at sea.

The galaxies were grouped in neighbourhoods, in spacious open arrangements, their fissive momentum constrained by a force, an energy no human could see, no instrument could detect, a penumbra of enormous power, a mystic's gravity that grasps the stars as stiffly as a massive blob of epoxy grips a spray of sand.

Galaxies, in fact, were tiny exceptions of light in a much, much bigger unknown and blew through space like the blobs of foam, the ragged aggregations of froth all bubbled and shivery and irregular that blew across the shallows where I ran, ragged yet structured aggregations, somehow explicable to the brooding mind,

which tore and shivered and flew past my feet while the sea roared its dark roar.

Expansion implied something new, something so different it shook my thoughts. If beach and sea, the arch of the Milky Way had not been present for all eternity, discernible in the backward disappearing abyss of always quick forwarding time there was a start, a genesis in miniscule to the huge explosion in which I lived.

How did I know, how could a lover of literature whose science was rudimentary be certain this was so? Was astrophysics not the terminus of calm, eternal facts? I made what I could of the evidence, the radiation quietly quivering the universe which hissed in tuned-in headphones like faint reverberations of an ancient bang, the red-shifted light from the galaxies, the jiggling snow on a television screen.

I felt at times much like the abacus-schooled merchants, jewellers and smiths who shook their heads in the synagogues of small hot towns in ancient Greece when Paul the Apostle stood before them, presenting the evidence of a miracle, save that the resurrection seemed the more modest, the less outrageous event.

For casually dressed in jeans and beards, some place, some time in my youth, a group of cosmologists, astronomers and other assorted minders of the skies had stood outside a conference-centre room, ready to announce to the world what they having weighed up the data had with some dissent at last agreed - the steady-state model of the universe no longer fitting the numbers, the facts, the better paradigm was this: a vast exploding sphere of energy, mass and time.

The implications left me trembling and aghast. Everything seen and unseen, billions of years ago, had burst in a moment out of nothing, a vacuum, a nix. Out of the perfect intimacy of a single imagined speck of energy and time, out of a mote of mass much, much smaller than a muon or a gluon or a quark all things came flying - the galaxies and the galaxy-big clouds of gas and dust, the constellations glittering in the sky at night, the sun and sky we see by day, the earth, the polar caps, the continents, seas and cloud-topped Andean peaks, each tree and stream, each town, each dwelling place, this page, you and me out of that primordial speck came flying outwards and onwards with all time.

Astonishment crashes through me, even today, when I attempt to vision this, reading perhaps about a marvel found by astrophysics or paleomicrobiology in scientific journals whose codes and formulae remain forever out of reach, a scared astonishment that makes me sense again how little minds can know, that fades, quickly, and not without relief into a kind of numbed indifference when someone hoots outside or some new email flaps a pennant on the screen.

That is, I reckon, a way of coping with the size of things that science reveals, a way of domesticating the terrifying magnitude of the habitat around our heads, of sliding to one side the questions that science asks our psyches and our art, Did the universe happen by chance? and Why am I here, able to ask such things?

When science, the discoveries of science force-field in us incredulity and awe, who knows, a fuller art may start to resonate its colour, its music and its words, for such emotions earth us in a greater being, dissolve the disjunctions we make between our bodies and our cosmic genesis and fuse together, albeit for a moment

the separate development schemes that come and go in the homelands of the mind.

Awe especially, the awe that the frequent discoveries of science release within us, awe humbles the anthropocentric hubris that is I say the curse of Homo intelligens and searchlights the flatlands, the billboards, the vacant lots of prose in the mind.

I've sometimes felt such awe, not only running in the mountains or down a beach but body-surfing as well, when riding in on those pulse-beats of energy the waves, on what I'd now perceive as manifestations to my senses of invisible complexities, the angular momentum of the spinning earth, the gravitational flux of the moon.

You know the feeling I mean, when riding on a crest that suddenly starts to plunge you stare down at the shallow green water below with a clarity induced by fright and see as if you've never noticed them before the bubbles popping in the foam, the sunlight sparkling on the ruffled water, the sand-grains churning up in clouds, a turbulence, a hectic interplay of elements all quite unsympathetic to your plight.

Then, putting aside for a moment your insights into the meta-biology of a swim, you realise that death or at least a nasty injury to your vertebrae is close at hand, whereupon with astonishing speed, you decide to deepen your unity with nature, and closing your eyes, holding your breath and clasping your head in your arms you curl up and go head-over-heels in a terrifying tumbling thrash of wet energy and skid out, flat on your belly, in the foaming slop and swill of the expiring surf, and lie there, spluttering, with your arms akimbo, your sinuses stuffed with water, your eyes smarting, your chest thumping, your hair and costume thick with sand, feeling strangely exhilarated as you stagger to your knees to be alive, alive, alive.

The turmoil induced in the mind by science can be as turbid as that dumper.
Think of the numbers which proved that the earth was not the centre of things,
the fossils which proved that Abraham's ancestors resembled a troupe of apes.

Think of the quarrels, not only with laity, but among the scientists as well,
about the origins of a new disease, the classification of genes, a butterfly,
the benefits of coal and nuclear power as well as those apogees of acrimony,
disputes about the existence of a Primum Mobile, a Source-of-All-Energy,
an architect of proton pumps, the fine structure constant, galaxies and cells.

What can a neophyte say when brilliant scholars bicker nastily for years
with grunts, with groans of animus as ancient as the psalmist with a lyre
bemoaning the slaughter, the godless suffering, the sins of the Holy Land,
in arguments as antediluvian, it could be argued, as the loops in the brain
which lodge in humans the liberty to analyse, elucidate and then to doubt.

What can the amateur, the lay cosmologist do, quite busy with other pursuits,
like toiling for hours at work or fetching and ferrying the young round town,
when one fine fuming geneticist, pounding the pulpit of unbelief declares
that Darwin and chance both verify that no divinity's at work in the world
and some retort that science is a great equivocator when it comes to faith
and others hold forth that natural selection has nudged at last into secular life
a gene which makes a brainy brutal species yearn for meaning, art and GΩd?

How do devoted disciples of all that's rational, intelligent and reasonable
interpret the swift demise of the scientific materialism of Lenin and Marx,

those texts that millions had died for tossed onto the back of a garbage truck and driven with the slops from kitchen bins right out of the university gate, and that apart, how does the moderate Mephistopheles, the reasoning priest evaluate the differing paradigms of science, the contradictory explanations that sit together as comfortably as fundamentalists from rival faiths at a meal?

I mean the Janus-like duality of light, its schizophrenic photons and waves, the misfit between Newton's mechanics and the fuzz in the quantum domain, the deep equivocation of energy - jumping orbits, fizzing into mass then fire - the large-scale arrays that morph into new ones with qualities not in the old, the thought-tracks of researchers forever diverging, puzzling, probing the new.

How malleable, how multiplex is life! The snub-nosed submarines of science drift slowly through abyssal deeps, down long ravines, past ghostly crags their portholes ablaze, a spotlight fading a little distance in front of their hulls.

When still a boy, I'd sometimes sit inside the planetarium in Cape Town's lap and watch the constellations drift across the little hemisphere above my head. How wonderful it was, to see the Dog Star and the Southern Cross begin to rise and hear a cheerful voice explain why that star there was red and that one white.

I realise now, when I recall how my young consciousness expanded with each show that science, for all its human strengths and contradictions, its fallibilities and fuss, science had shown the public in that room a verifiable illusion of a greater reality, an esemplastic metaphor of the stars. How could such science illuminate the arts?

The metaphors of science are true, as true as the views from a Drakensberg pass.
They fusion for a moment the inscapes, the shouts of Eureka! I've got it! Got it!
that echo in a lab or the field, that shape slowly from years and years of research
of puzzled, creative wrangling with megabytes of confusing, disparate information
in search of a unifying principle, an equation, a sweetly simple predictive insight,
those incomplete models of understanding in time, which are the business of science.

Such theories are verisimilitudes of life, evoked in the four languages of science,
the public discourse of prosaic speech, the site-specific hieroglyph of the diagram,
the coded formulae of natural science and the immaculate finesse of mathematics.

Four languages you ask? Please somersault with me now in a surf of abstractions
by entering a thought-wave that emerges from physical cosmology's turbulent sea.
To help understand the framework of initial constants in which the universe began
Penrose the mathematician describes in publicly accessible prose a number of terms,
concepts like phase-space, the entropy of baryons and curvature tensors in space-time
each one I think you'd agree a kind of scientific metaphor, a technical figure of speech
that refers to conceptual, to inferred realities more complex than the terms themselves.

He adds a diagram, which looks like a hot-air balloon sailing in a cloud of words,
refers to the chemistry and physics, the hydrogen nuclei of the primordial ball of fire
and then states his conclusion in a mixture of metaphors, both verbal and numerical.

The gist of it is this. To produce another universe resembling the one in which we live,
the Creator, his metaphor, would have to select one set, one recipe of initial conditions
from among the enormous number of other recipes able to create all other universes.
The selection would have to be precise as pinpointing one in a number of possibilities,

one, he calculates, in a stupendous ten to the power of one hundred and twenty three.

We humans make the mathematics but the numbers shoot out from under our feet.

One part in ten to the power of one hundred and twenty three. Really? You sure?

Isn't that a vanity, a puff of mind that sneering Voltaire would pierce with his pen?

Penrose is forced to conjure up another metaphor. Were we to write a nought

he says, on every proton, on every separate neutron inside this massive universe

that still wouldn't be enough space for the number of noughts in the calculation.

What can that mean to us, who can't imagine each face in an orchestra at once?

Language. Language. Language. By now you'll be I think beginning to perceive that language, consciousness, the world in which we live are interactive entities embedded in a bigger reality, the expanding, resinous gelatine of energy and time.

As helium burst out of hydrogen, as carbon, iron and all the other heavy metals exploded from the nuclear reactors of the stars, as elementary organisms on earth evolved into plants and fish and animals, so complex systems gradually emerged, systems as intricate as the photon-snagging carbon rings in the chlorophyll of a leaf, the muscles in the thigh of a flea, the radar of a fruit-bat, the genome inside a cell.

Unlike the steady-state habitat, the clockwork cosmos that Newton engineered, ours is a verifiable model, an incomplete metaphor of a universe that had a start, where space-time is not the eternal circling of the stars within a static domain but has the look of a thistle, the disorderly order of a thistle opening in a gale. Such science has this to say: it takes a universe this large, this complex and old to create the possibility that life, the most complex system of all, will appear.

Language. Language. Language. Where else but in the languages of the species do such new metaphors of the cosmos unfold? The languages of measurement, of calculation and prediction, which is science, the languages of interpretation, of meaning, purpose and transcendence which is the Babel discourse of the arts, with no metaphor separable from the rest, each shaped by the aesthetics of form. Science by this analogy is the language of facts and the arts a discourse of truths.

How then does the discourse of the arts absorb the particle bombardment of facts that science releases each day, the facts of expansion, of individuated complexity? How can the arts make artefacts of significance in a hurricane of digital data when meaning to us is inversely proportional to the sum of its undigested facts?

You probably have awakened, I imagine, in the middle of the night at home disturbed, you initially think, by the wailing of a siren in some distant street. Above a roof you glimpse perhaps the faint glint of a small anonymous star then shut your eyes and try again to sleep. Unasked for, as it were, unbidden the memory of a friend appears, and then concern about some issue at work, hurt anger at some imagined insult or drab anxiety about the future of a child. This is, I'd say, the consciousness at work and visible, seething, sorting, sighing, aggregating our memories of the minutiae of experience into cause and effect, connecting our present behaviour with past experiences of pleasure and pain and yearning, yearning for meaning with a restless energy also desirous of rest.

I woke one night in such a restless mode of mind when trying to create this poem.

For days and days, I'd struggled to understand how the consciousness of the artist could grow to absorb and work into significance the facts of expanding complexity. How could such diversity, such fragmenting details ever coalesce in the mind? Should hours of contemplation visioning the cosmos precede the creative act? Should artists become as handy with mathematics as Della Francesca had been?

I groaned aloud, trying to adumbrate the metaphors I'd made and discarded, metaphors that ended in numbers, that disincarnated the feeling, breathing self until my wife called out, 'What's the matter?' turned on her side and sighed.

I fell asleep, but hours later it felt as if a fledging was pecking a hole in its egg. Who knows what really happened? The push, push, push of an urgent thought, the pressure of a single word burst through my sleep and suddenly I was awake, sort of awake and asleep and joyful all at once. Love was the word that woke me. Love I saw then could bring the facts of cosmic complexity into the truths of art, not the love tied up in the ragbag English word, but the three dimensions of love I'd read about and cherished, the agape, the eros and caritas evoked by theology.

With eyes still shut, I tried to imagine a force-field of love at work in the mind, a force-field, in three domains, that fused into art the multiplicity of science then glimpsed a blur, a soft glimmering in the dome-like cavity of my skull. It looked like a cloud of particles, a transparent block of unworked marble, a stand-alone hologram in a virtual art-gallery awaiting the sculpture's hand, a vision that has not passed from my memory and guides this text, even today

Well let me end with an experiment, conducted in the laboratory of a text,

a thought experiment in which I'd like to test the truthfulness of my eureka,
that three-dimensioned love can morph a theory of science into a work of art.

My starting point's the chemistry, the biology and the physics of a grain of sand
and you as well, the audience, the patient examiners of this experiment in words,
my human peers and peer reviewers with whom and for whom such art is made.

Allow me then to wet the spiral on a fingertip in the spittle of my mortal tongue.
Then let me dab me it down, onto the grains of sand I've scattered across a page,
and lift into my sight and yours a single grain. Look - a tiny tawny-brown grain.

It is I think a kind of silicon, an element cooked inside the fusion reactor of a star,
the roaring, bulging nuclear factory of the star which bursting billions of years ago
spewed out the dust of minerals from which this earth and you and I are made.
Silicon and oxygen, fused into a latticework of molecules, a rough speck of quartz.

Look, a rounded surface, here and there, as if the gravity that pulsed the tides,
the surf of a beach had ground a hallmark, a signature on the smallest of things.
Look closer, if you will. Can you not see, inside that indentation near the top,
a ledge of molecules and set in the crystalline wall that rises above the ledge,
not that one, the wall with the austere green lacework of lichen in the corner,
can you not see the fossil of a nano-sized creature set in a niche in the wall?

You can, if you want to, call this a diatom preserved in silicate, or you can see
a chapel that entombs ancestral life, a multi-faith memorial where we have come
to celebrate the life of our tiny forebears, their struggle in hot acidulous seas,
for millions and millions of years, to survive, to replicate and perhaps improve.

Now look at the fossil more carefully. Can you not see, stuck against the quartz, and rounded as the membrane of a lizard's egg, a mummified vestige of carbon? That was perhaps the belly of a life. Now see in that the star which gave it birth, the star whose burning hydrogen was squeezed by gravity for three million years before it could gestate one molecule of the carbon that crafted life into that cell.

Look deeper now, right through the crystal wall and hear among the molecules the resonance of the atoms, humming with a frequency that shapes the nuclei, humming like swarm after swarm of bees, like Buddhist monks in templed prayer that resonates deep down within the structuring energy of all observable things.

Choose last one nucleus, just one from inside the layer of atoms above the ledge which seethe with silent energy like lightning in the clouds far out across the sea. Does that seem difficult? Please focus then, please gently and lovingly enhance the force-field of your imagination, the image in the hologram alive in your mind.

Now pick out a nucleus of silicon, with all the intimacies of electromagnetism fizzing and fuzzing and flashing in the mist of quarks and gluons at its core and remember how exactly the poise, the balance of the forces is engineered, the fine structure constant at work in every nucleus of matter we can know.

Think then of the hot explosion of energetic matter and antimatter at the start, the emergence of gas, stars, dust and galaxies out of a framework of constants, of precise guiding parameters and see in the micro-architecture of the nucleus the macro-engineering of the universe and the bio-electronics of the brain.

Language. Language. Language. Metaphor after metaphor, opening, linking.

If you by now have glimpsed, albeit for a flash, the cosmos in this grain of sand
don't be surprised if awe shimmers a metaphor of metaphors within your mind,
don't be reluctant to say with Newton, with Einstein, Blake and other such seers
in different continents of languaged culture round the planet's lingui-sphere,
Laudate Dominum. Shanti shanti. Om Om. Masimbonge Somandla. Amen. Amen.