

Planet Earth

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A Brief Geological Excursion
Through the British Isles

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by Colin John Holcombe

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1. To Start

My friends, let's start. I'd like to talk throughout these pages on the ways one simple (I would say emergent) concept has regained the wholeness in our view of planet earth.

More, if I elaborate a moment — our love, our wonder, adoration — what do I refer to? Yes, to biospheric processes. You smile. But take an atlas:

there you have them — all the planets, earth the third one out. Not the fastest moving, most spectacular, you'd think to any alien now visiting, would you? Just

a small spot turning round an oblate orbit extending far in space. If sun's a football, earth's a pinhead thirty yards away, with Pluto at the end, oblique in orbit,

and twinkling out a thousand yards in space that stretches on this scale four thousand miles to alpha Centaur, known our nearest star. More dust and nothingness is what we are.

Note

See an atlas or elementary textbook on astronomy for details of the solar system. Included in biospheric processes are the degassing of the mantle, the movement of crustal plates, the constant erosion of the rocks and their reinstatements in continental accretion, the role of atmosphere and water and all the myriad forms of life in the complex, interlinked and ever-changing world we inhabit.

2. Subsequently

Yes, we say, of course. And quit our musings,
to go into the falling sunshine, to the warm,
full, breathing world, the thick-with-birdsong,
asking if such progenies could still be true?

But what did Pascal say? And Leibniz — space
immeasurable, illimitable, and bending
round as Einstein thought, and never thinning:
in no wise, in no place, and to no thing.

Gentlemen — let me take you down
now to the very basement of those minds,
to the souls crying out in torment from
a world evacuated of its spheres:

For why, O God, has Thou forsaken us
among the entrails of a dusty earth?
From Noah unto Jeremiah Thy glory
flamed from mountain top to mountain top.

That was a way of putting it, with angels
choiring to the empyrean — and gods,
as Shelley saw them, household guests. You
believe that, do you? No? Well, let us think.

Note

Geologically, the earth's 4,500 million years of existence is divided into seven great eras of time — Hadean, Archean, Proterozoic, Palaeozoic, Mesozoic, Tertiary and Quaternary. Each era is further divided into periods. The 570-220 mybp (million years before present) Palaeozoic era comprises the Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian periods. The 225-60 mybp Mesozoic era comprises the Triassic, Jurassic and Cretaceous. The 60-2 mybp Tertiary era comprises the Eocene, Oligocene, Miocene and Pliocene. The 2-0 mybp Quaternary era is divided into the Pleistocene and Recent periods.

3. In the Beginning

Since somewhere in the vastness was our beginning,
in the coalescing and melting as they crashed down —
ice-comets and planetesimals — to make
the core, the mantle and the homely crust,

we have attachments in us to those vast implosions —
to the first time, the far time, to a time entrammelled
in our make-up, our dreaming, to worlds no doubt
prefigured before us in those distant places.

So, if now of the Hadean there is nothing
recorded — not in rocks, in the heights or in the depths
and only by foraging on the moon's wan surface,
collecting up splinters, can we trace it through —

we must remember now to put aside
the colossi of theories that do not reach
to the plainness of matter, its obdurate nature,
its inertness to us, though not indifference.

For threaded in us, and through us, however briefly,
there is meaning, and making of our various lives.
Out of the stars we have come, and our immortal longings
brim in the evening if we will see it so.

Note

Cosmologists believe that the heavier elements making ourselves and our solar system were formed aeons ago in vanished stellar processes. The greater portion of this dust and gas coalesced to form the sun. The remainder collected first into planetesimals orbiting the sun and then by a process of gravity capture into the present planets. The earth formed some 4.5 billion years ago, but of this first Hadean period, lasting until 3.8 billion years ago, there is now no trace. But during this period the core and mantle separated from the crust, and the latter, still rather different from the crust as we know it, suffered the heavy meteorite bombardment that we see preserved today in lunar craters.

4. Our Sister Venus

If what we hoped for was an Alpine glacier
limpid and glistening in the early light — it's not,
but basalt under sulphur gas, and hot,
(O goddess shining through the evening and

the dawn, trailing, with the sun still setting after
in your most beautiful of clear blue light)
the tesserae broken, digitate and then
half lost in heavy lava swells. And more

than that, much worse, beyond the ugly pock
marks of the meteorites, the gaping craters,
there are the vast coronae, miles across,

and chains of glistening vininulae —
meaning (O Latin goddess, necklaces,
round you the most voluptuous when most naked
and fecundly embraced) degassing sphincters
in this crushed wilderness of poison gas.

And so perhaps uncannily (O Goddess), since
the ancients knew of Helen and her beauty,
you, beyond all other avatars, become
at last coincident with what was thought.

Note

Venus is important to planetary geologists. Its features — an old tessellate ground largely buried by outpourings of basaltic lavas from great coronae centres, and this whole surface pockmarked by craters from continuing meteorite impact — may well depict the earth in its early stages, before water appeared in any quantity and the mantle congealed into mobile crustal plates.

5. The Moon

Certainly, because we have landed there
our markers, astronauts and our sampling gear,
and found life missing, completely, not a trace
of microbes or algae or of things like us,

we must undo all notions of a life
beyond this empty rock. It's only lava:
long, long floods that in the drop on drop
of meteorites has turned to glistening dust.

So what, at this distance, does it mean to stare
at a blank reflection, one glass eye
that is brazen, moreover, with not a trace
about it lovers in their midnight excursions

would seek as a blessing? Like a vast film set
littered with has-beens, it's a blistered front
hung in the air listless, is not boarded up
because there's nothing but the frame instead.

I do not have answers, but the sumptuous gloss
of moonlight on darkness will have come between
the us that we know and a world once becoming:
that stopped, and turned other, and has stayed as rock.

Note

The moon is a dead world which formed much the same time as the earth — i.e. about 4,600 mybp. The oldest lunar rocks date to 4,000 mybp., and the lava outpourings to some 3,200 mybp. Thereafter, nothing much has happened — except the relentless fall of meteorites that have dug craters, pulverised the surface and created the glass droplets prominent in moon samples.

6. This Uncertain Earth

All things are in motion and this dull spot wobbling about slowly in its draughty slot on the uncertain ecliptic, can never stop here or for anyone. And is therefore not

an exemplar for children — however taught that force is no mystery, that Newton fought nothing of conscience to have each orb speak of his God in the 'is' and 'ought'.

Fatuous, of course. What practical use is a calculus or more that won't produce a certainty beyond what was Gödel's proof? Arithmetic even is not certain truth.

Which leaves us, I suppose, as all things must, floundering with concepts like hope or trust, with souls that God moulded out of febrile dust. Well, so they once said, but it comes to us

as a heartbeat uncertain, from an earth whose sense is to head for the centre, and never go hence. Distant as pin-picks, the sky's Maundy pence have no cause or reason for eloquence.

Note

We live with uncertainty more than is commonly realised. Mathematics — that most sure of reasoned truths — cannot be derived from logic, or even necessarily from its own axioms, as Gödel has shown. Logic, moreover, rests only on our human sense of intuition, that something is true and can't be otherwise. And in the world outside, the world known to science, the earth hovers always on the edge of disturbance. Besides precession and nutation, the Euler and Chandler wobbles, there are the smaller disturbances created by atmospheric loading, ocean currents, winds, mantle convection, plate movement, earthquakes and electro-magnetic coupling. Much more serious are the small perturbations caused by the intergravitational interactions of all the planets acting together in a quasi-chaotic way, which could one day throw the earth from its orbit, breaking the planet into a second asteroid belt. The likelihood of such catastrophe is very small, but exists and will always exist.

7. Meteorites

For the most part they come from God knows where,
with nothing in the nature of an explanation.

They fall, and are found, as though casually flung
from the high front of Heaven — out of which they've fought

a long flight like Lucifer down to earth.

From the heat which basted they have their bat-like skin —
cindery or webbed as that may be — but what
their insides record is the strange world they're from.

Which puzzled the ancients. To us they speak
of collisions in orbits, and in this important
in giving us insight of the deep core within,
of earth as it was, in the first melt of life.

And for this we brood on the museum cases,
study the descriptions, the polished sections,
watch the light travel the grid-locked lamellae
of nickel and iron, the offensive placings,

and know they are strangers, and always inert
to any long sojourn in the heart's affections:
always inflexible was the hard world they knew,
and hard the down-pull still that draws our feet.

Note

Meteorites are small bodies from space that are drawn by gravity through the earth's atmosphere, where most burn up. Their source is probably the asteroid belt, though some may originate from comets or even the other planets. Several classes are recognised - chondrites (silicate minerals), irons (98% iron and nickel) and stony irons (50% iron and 50% silicates). Their proportions and composition suggest that they represent parts of planetary bodies not otherwise accessible to us — and as such are very valuable to geophysicists wanting to know how our own earth is constituted.

8. Cosmic Radiation

We all know such nights in early summer,
when to stand at the window motionless
is to merge in the stasis, to become as one
with the trees held astonished in the still, rapt sound.

Without substance, we are as the ether reaching
into the thick, warm substrate of the night,
though borne up always by the immense light being
of the wind through the bacilli of shadowed leaves.

But in fact this is nothing to the incessant raining
down of a starlight almost drenching the bone
with a muzzie bedazzlement, an all-about
buzzing and a weaving of our inmost threads.

The pions, the muons, even the fierce small particles
that burn on through even matter itself,
clean through the earth whistling, and go on whistling,
always to the future, which is where they are

implicating and weaving far out in space —
if we listen, breath quiet, through every fibre —
to a song more haunting and delicate
than ever was moonlight that stunned these trees.

Note

High energy particles emitted from supernova (exploding stars) enter the earth's atmosphere constantly. Such cosmic rays generally collide with the molecules of air, creating a shower of further particles like muons and pions, but some pass on through the earth itself. Although elementary particles are now more readily studied with high-speed cyclotrons, cosmic rays and their associated gamma and X-ray emissions still give valuable information on stellar processes happening far out in space.

9. The Archaen

Indurated, firstly. They make hard ground.
Also intractable, becoming round
by effacement in pebbles, by slow degrees
of incessant pounding in our northern seas.

A fiery, however, and protracted birth
for these the oldest that we have on earth:
the gneisses, granites, the charnockites
register strongly that they know their rights,

indeed will assert them. If you take a lens
and look at the fabric, each crystal fends
off from itself thin slithers of the same
silicates that give the rock its name.

Hard then, withholding. They do not make
tabular lumps, lamellae, but only break
criss-cross, as surf does on rocky shores
or the osprey clutching at wind-worn tors.

So fissured with them as an intricate stain
are the eons of shifting and of blended strain.
Hard-fanged always, with the fire beneath,
they hiss and break open into dragon's teeth.

Note

The Archaen are the earliest of rocks still preserved in the earth's crust. They are igneous (granites and lavas of various types), metamorphic (schists and gneisses) and most sorts of sedimentaries (notably greywackes, dolomites, shales, and cherts). They often form the interior parts on continents, but in Europe are found on the northern shores of Scotland, in Scandinavia and Greenland.

10. The Early Crust

Of course it was different, that early crust:
chaotic, thinner, and mixed with much
toffee-like foldings, long wrapped-up bits
of greywackes sediments round granite blobs.

Unravelling, we find that they all poured out —
the lavas from basic to acid and thence to chert,
on which, and gradually, through countless aeons,
came the quartzites, the shales, and the banded irons.

In this nothing unusual — not in the crustal
swellings, the hot-spots, etc. — no, all very normal
once there was oxygen, made good by plants,
algae perhaps, then the slow advance

spread green on the planet. And what we've got
of monsters or floods or the hand of God
is nothing, not a thing, to show earth's been
a page abstracted from some primal scream.

Both pointless and stupid. It has not altered
by the smallest jot in the things important:
not in seasons, in weather, or the rocky climb
of continents out of the earth's slow time.

Note

Archaen rocks, i.e. dating from 3,800 to 2500 mybp., common appear as granitic domes surrounded by rocks of greenish appearance: the so-called greenstone belts. Usually the rocks have been repeatedly folded, metamorphosed and intruded. But where they have escaped this deformation it is very clear that they were made by processes still making rocks today. Very probably the continental masses were smaller, however, and there is much debate over the exact nature and movement of the crust at this time.

11. The Proterozoic

To those who travel these isles, the very names indicate the dull reds, oranges and greens that stain the sands, conglomerates and shales with origins so clearly non-marine.

Molasse is the generic name that's given these, the first torrents from the mountain ranges. Uriconian, Torridonian — and what they speak of is a bold new start.

Because, this time, there comes abundant life: unicellular, to algae lastly.

So: volcanoes cease, the earth cools, and small things start upon their quiet advance.

But of course very slowly; they take three times longer to evolve than life. yet it is wonderful how they link together the yeasts, the proteins, the amino acids —

building themselves out of these hard schists, quartzes and pyroclastics in an angularly pebbled determination to take it further — and so, to make a pun of it, pure grit.

Note

The Proterozoic embraces the great span of geologic time from the Archean to the appearance of invertebrate fossils in the Cambrian, i.e. from 2,500 to 570 mybp. There was no great change at the end of the Archean, but many of the present-day continental masses were apparently in existence, at least in embryo, and the arcuate greenstone belts are now replaced by long mountain belts of intensely folded rocks — suggesting subduction at plate boundaries had already started. And with the change to something more like the present earth came the evolution of life, spreading from simple unicellular creatures to the widely diversified forms that characterise the Cambrian and later rocks.

12. Life and the First Fossils

First the inconvenience: they were not assuredly fossils for a moment, but enclosures occasionally in some cross-grained rock far too ancient to be algal-marked.

Yes, it was circular, but not the worst for being so blatant, till some banded chert came from Australia, the Warrawoona flats which put, quite securely, an end to that.

Six times older than the invertebrates! A staggering thought, which should bring to flights in the slow lanes of history some reflection as we work our way back to that starting point.

For chert is but silica, close to carbon: indeed can be structured, and has been elaborately melted, remelted, and thereby spun out in the layers of the whole substratum.

But not into life. No, that's not occurred — at least as the concept has so far been used — but then silica I suppose, is the one thing to last some final cataclysmic holocaust.

Note

The record of earliest life on earth has now been pushed far back into geologic time — to rocks of the Warrawoona Group, some 3,500 mybp. Evidence of life at a later date, but still in the Archean, has also been found in South Africa, Canada, Greenland and other localities in Australia. The organisms were very primitive, of course: filaments of an algal appearance, sometimes single units or mats of sediment-trapping colonies called stromatolites. Chert is a form of silica (silicon dioxide) and probably originated in volcanic activity. The silicates — silicon, oxygen and metallic elements — form a very wide variety of rocks - anything from mantle constituents to common muds and clays.

13. Trilobites

Fatuously simple. The first-year student should have no trouble in depicting their broad three-fold arrangement in length and across: there is always a thorax, a head, and tail.

Some have large eyes, some spines. Occasionally the head may be pitted, have crenulations; but for the most part they're plain, usually look about as prepossessing as a dinner plate.

Not that it matters. Immensely successful, they come in hundreds upon hundreds of different genera. And all of them — think! — were flicking feet and feelers over the offal collecting in fetid hollows.

In millions, moreover: that's the horror. Wherever was mud, or weed, or out in moving waters, there they were too — and were moulting and diving, undisputed the keystone of the whole creation.

And what did that lead to? Not the phylum chordata, a second fecundity from the Burgess Shale. No. All that is true of such plain creations is how relentlessly they ate and bred.

Note

Trilobites were marine arthropods that resemble flattened woodlice. The name comes from the three lobe nature of central ridge and two side lobes, but they also divide into head, thorax and tail. Trilobites became extinct in the Palaeozoic, but were very successful in their time — they lasted over 300 million years, and evolved into something approaching ten thousand different species. The Burgess shale is famous for its exotic Cambrian fauna, evolutionary novelties that fade out as suddenly as they appear.

14. Wales and Graptolites

So down a fathom and then a fathom and after
the cold waters closed over how could they know
how precipitous the drop was, or on what
glutinous surfaces their fronds would lie?

Huge and seeming as an accumulation
or darkening as of autumn in the miles above —
an immense flagellation of small things
like keys of sycamores that floated down.

Who can grasp the mountainousness of it,
the flaccid accrediting of layer on layer,
the countless millennia of that long time tightening
by foldings and pressings into spotted slate?

So if you think that you can put away
something unchanged for its millions of years
in the miles beneath the abysmal waters,
with occasionally a current to spread fine silt,

then you have no conception of those great deeps
and cannot take up what that time will give:
like a blink of the eyelid are the soft impressions
of the lifelines suspended but still pouring in.

Note

Graptolites are a class of enigmatic creatures which inhabited colonies of tiny saw-edged tubes. Though extinct by the end of the Carboniferous period, these free-floating, planktonic animals spread over vast distances of the Palaeozoic seas, and are the only common fossils in many deep-water sediments.

15. Linguella

Perhaps of all the Lord's creatures, these have lasted
the longest, these brachiopods called Linguella.
And being so contented, and indeed restricted,
they've seen off the dinosaurs and may so us.

There is reason to think it, but we'd not conflate
life with longevity, or be content to sit
day in and day out just kneading water.
Are really the shorter more compelling proofs?

Not in heart-beats only, but by breathing through
all which has lasted must we come of age:
the lash of seas, winds, the torrential sun,
even planets above us, are our lifeblood here.

Is there no drop down to an inner being,
a surging emptiness where words give way
to denseness, compactness — no conceptions but
a something inhabiting beyond all sense?

Yes, and we fight this, say we're different, see
no interchange even in our thought and fact.
But earth is our ruler, our retainer, life
but an endless completing of all that is.

Note

Linguella is a brachiopod, a shellfish that has lasted practically unchanged from the Ordovician period. The shell is unremarkable: two-valved, oval and an inch in length. Like all brachiopods, the animal lives by filtering seawater through a coil of tiny tentacles that occupy the internal chamber of the shell.

16. The Depths

To these vast depths through which the sunlight has never filtered, nor blackness retreated while earth had waters, where currents don't move or the soft air bubble, time, that's unabsorbent, stays unbroken.

Things that therefore do drift down, over the millennia winnowed, dissolving, almost fining away — a whale's ear, red dust, a radiolarium — all seem fragile and exotic, not one with the fret

of the vast world they came from. The annelid worm Pogonophora can live for a thousand years, and fish drift slowly where the depths are extended into shifting centimetres in a year or less.

Such are the frigid and distal accumulations of things out of kilter with the surface rhythm of life going elsewhere or nowhere or to extinction in the mollusc, the shrimp or the coelacanth.

Adopted, adapted, estranged, held in by pressure not of the water so much as by depths themselves — whatever was old or strangely divergent becomes the new form in these fathomless depths.

Note

The great ocean depths occur at subduction zones, where the earth's lithospheric plates are consumed. The plates and the zones themselves move very slowly, a few centimetres a year at most, and so persist over many millions of years. The animals of these depths have adapted to the great pressure and almost constant conditions — most notably in slow growth and long lives.

17. Orogenies

For a long time, to the thoughtful, it brought some grief:
earth piled on earth, with the squashy seas
uplifted to the mountains, to their very tops:
if life was everlasting, this world was not.

Also to be counted were earthquakes, fires, floods
that men from wickedness should be seared and washed.
And ever, all about them, lay the Devil's things:
the ammonite horns and his thunderbolts.

Under a righteous and indignant God
we all of us lived then. It was His hand
that dowered with miracles or had the rock
break out in fountains or in evening blood.

Fanciful? Parables? Hardly: earth
was different but certain, above all perduring.
However one travelled, the land rolled on,
or the sea did, for ever, beyond all maps.

Fossils and sediments were portents when bones
could be tumbled as pebbles by the mountain bourne.
For in the end we were dust, entirely, but
that also was His, and invoked our trust.

Notes

Mountain-building episodes — or orogenies as geologists call them — cause the thin veneers of sediment to be uplifted, folded and changed in composition and appearance. Various surviving in them are the fossils, which the Greeks recognised as remains of past life but which for long periods afterwards were seen as relicts of the great flood, or even as manifestations of the Devil. It is only in the last few decades that plate tectonics has given a convincing picture of how continents come to be in movement, and their associated sediments deformed at plate margins.

18. Old Red Sandstone Fish

Placoderms we call them — the plated fish —
odd things but important, if only because
here for the first time is a heavy armour
quite unconnected with the deep inside.

Of course you can't see that, these Scottish slates
have smeared and hardened the outer bits.
But the innards were built round a flexible core —
i.e. a long bony chain: the vertebrae.

Support, articulation, the soft nerve fibres
enclosed and protected by the threading rings.
Much then was beckoning, and not the least
the hollow that opened to become the skull.

Here, for the first time we see how the paths pan out:
herbivores, carnivores, in both the same —
the brains are kept separate from the outside air,
and thinking no portion of the sensate parts.

And that, in the essence, is what we do:
to see what is outside through the inside weaving:
if played in the skull is the fire of heaven, outside
remained Hiroshima and Auschwitz blood.

Note

Placoderms or platy-skins were among the first vertebrates. These fish had jaws and paired fins, but their most characteristic feature was a bony armour covering the head and forepart of the body. Placoderms appeared in the Silurian, dominated the 395-345 mybp. Devonian period, and became extinct in the Carboniferous under competition from sharks and other fish. Some of their best-known fossils come from the Old Red Sandstone (Devonian) slates of Scotland.

19. The Wenlock Limestone

And I would come in, morosely, with
my father on those cold, numb days, the rain
still dripping from our macs and brollies,
to stand and marvel at the marble stalls.

Glittering above me were the elaborate tops,
polished in copper or brass with some verdigris,
and a long beard down in grey or yellow
that took the gloss off what was breathing rock.

Settled around me were corals and bryozoa,
a chambered nautiloid or a sectioned shell,
but particularly the crinoids, like paper stiffeners,
their stems half composing the speckled rock.

And therefore it did seem a desecration
to piddle for long on this packed display,
this gleaming cross section through the reef material
that rose on both sides like a Papal throne.

And more than that, thinking — as the hills were quarried,
the Wenlock and the Aymesbury, and the rain came down —
there were drifting about us the new welfare claimants:
a broken detritus that was also us.

Note

The Wenlock is a particularly fossiliferous reef limestone of Silurian age that crops out in the Midlands and Welsh borderlands, and has been extensively used as 'marble' in municipal buildings — particularly in the more resplendent of Victorian buildings: town halls, museums and public conveniences. Corals, sponges, bryozoa and crinoid are all invertebrates, the last generally occurring as stem segments or ossicles, which stand out as small white rings against the predominantly darker colour of the limestone matrix.

20. The Arthropoda

Let us consider the Arthropoda, how tucked away they are in toughened sheaths — these that harden and bristle and which, if breached, hold only secretions and amazing tubes.

Yes, that's what they are, mere plated shells of chitinous armour, an impressive moulting hardening outward in each projection of antenna and claw, from their chrysalis on.

It may be therefore that this warm brown amber holding the spider and its entangled fly has immensely outdone them, for all that it too is only a little more complex than petroleum vapour.

But each of the inhabitants of this rich world is reflected and stilled. If you heat the amber you will fill out your nostrils with turpentine splendours that are gas now and gone into the North Sea deeps.

The fly, the globule of fluid in the abdomen — these you can see as the spider twists round. Yet for all that it's programmed it comes no nearer: watch the poison bags swell for one last burst.

Note

Arthropods (jointed-legged animals) are a very successful phylum that go back to the Cambrian period. They were marine animals at first, but by the Devonian were colonising the land and giving rise to the insects so familiar and abundant today. Most inhabit a chitinous skeleton, from which they moult as they grew larger. Many larval forms of course are grubs, which pupate and metamorphose into winged insects.

21. Stratigraphy

Hosanna! said the generations when they saw
the world that was teeming in each limestone block.
Surely, they concluded, our God was great,
and marvellous His handiwork, for who could not?

But for us considering these bryozoa,
corals, crinoid ossicles, brachiopods,
who know the genera and can look up species
in the gilt stratigraphy of the library shelves,

that splendour is only a monkish order
of division, subdivision, and discipline.
We focus more clearly or we write up notes,
point out the detail with our watercolour.

This is our law. How we want it. No
big words or shadows that could darken history,
no dowered extension of our causal lot
by the Lord, His cornucopia, the here or not.

How strange that would be! It is only particular
controversies that now return the past.
We go as technicians on our tepid business
of correcting, extending and of printing books.

Note

Stratigraphy is the study of the succession in layered rocks, occasionally dated by radiometric methods but more commonly by the fossils they contain. Given the wide diversity and detail of the geological record, stratigraphy tends to be methodical business that calls on other branches of geology as it needs them.

22. The Black Country and Coal

After all these eons there's an exhalation
from the partings, as in hot lands at evening
when the heat expands into rooms and doorways,
half filling the streets until it fines away.

But nothing like this: a brocaded plumpness,
large in concretions — a rich spattering about
of a raindrop exactness, in the spreading leaves:
somnolent as scarabs as they split apart.

So this was their ambiance: long reaches of rotting
tree stumps, oil patches, the stagnant bits stretching
for unending hundreds of humid, heat-stilled miles
large with amphibians and half-climbing fish.

But above all resplendent in the dragonflies —
enormous: wingspans up to a yard across —
which rose through the air, thin-bronzed and clicking,
their membranes a circuitry of silica chips.

Which they were in some ways, taking up sunlight
to warm their fluids for a tempestuous flight:
yet most of it carbon, filmy and glittering,
till it broke and flared down into bedded soot.

Note

Coal — compressed vegetable matter — is found in rocks of many ages, but the best known of the northern hemisphere date from the Carboniferous period when great swamps covered Europe and north America. In the swamps flourished many forms of life: giant club-mosses and horsetails, fish and primitive amphibians. But the most spectacular were the dragonflies, with wingspans up to a yard across.

23. Cornish Tin Deposits

The main thing is their smiling self-conceit
mixed with mute indifference. Pegmatites
extend whole miles like some vast Cheshire cat
with extravagant, glittering and ill-shaped teeth.

Which are quartz and plagioclase and mica,
mostly, and filling the all but crevices,
the last being those which gave passage through
for mineralising fluids the miners followed.

So, the last residuum of the Hercynian granites
speckled all the hills with their lodes and swellings,
with the gangue and ore, the specious minerals
that lit up their hopes, and still led them on

through roof-fall and adit, past threat of flooding,
emptying the chambers, the rich lodes thinning,
to vast new dominions: Ontario forests,
Ashante goldfields and the sweltering bull-dust flats.

To eventually the sky that was always above them,
a blue where the head-frames must rust away:
round them wind whistles as they lie with children,
gap-toothed, in cemeteries, without a name.

Note

Pegmatites are thick veins formed in the last cooling phases of granites. The veins are packed with large crystals of silicates — quartz, mica, plagioclase — and often with metals, which give them their economic importance. Many of the Cornish tin miners who developed their skills in extracting the tin, lead, zinc and tungsten from the lodes or mineralised veins that overlie the Hercynian (Permian) granites of southwest England, migrated in the nineteenth century to Canada, Australia, South Africa, finding and developing mines that are now mostly worked out.

24. Devon and the New Red Sandstone

I suppose after the drabness of country coming
up to London on the Penzance train —
the whale-back hills, small rivers, the hedge-trussed fields,
the spare clumps of trees by the white-walled farms

picked at and raw-tailed in the north-east wind —
it comes with some amazement to have these bright
red, friendly drapes of sandstone on the slates
still dark and splintery from the Palaeozoic.

And not inapt, really, as this detritus —
sands, grits, conglomerates thick with oxides
of the desert — were indeed mostly derived from
just these records of a compacted past.

Disposed of and lost. Here the glad heart lifts
to the nodular escarpments, the leafy ridges,
sedulous to the wind and the comfortable
rain at all seasons, to the country speaking

in the soft brogue of England, where things
which no doubt obtuse and lumbering, but not wholly
unlike ourselves, the dinosaurs and small mammals,
set up their homesteads for lives to come.

Note

Plate movements in the Permian threw up mountain ranges in the Appalachians, Rockies, Urals and Europe. The continents so fused together became great deserts in which the earlier rocks were eroded into conglomerates, sands, and clays, all coated with the red iron oxides characteristic of arid conditions. Later, in the Triassic, the continents began to break apart, the seas to come flooding back, and life to teem in shallow seas and adjoining land. In England these continental deposits are largely unfossiliferous, difficult to date exactly, and so commonly lumped together as the 'Permo-Trias'.

25. The First Reptiles

Before the world came to be with mammals and suchlike
flippancies, these huge, fanged creatures could
absorb the far-flung calcium, and the phosphate too,
and, thus impregnable, be made to last.

Always the sun warmed them and their small round eyes
roved through their colonies on the quiet beaches.
Like a top the heavens had to wind them up
and gently every evening to let them drop.

All were ponderously vacant, of course. But, if
awareness must also mean an intimate
interconnection of matter with motion, these
were faultlessly conscious and had the lot.

And this I would urge you to ponder as you look
on the stagger of footprints in the clay made stone.
From rock has come rock, as though earth undid
here something of itself in its own excursions.

Like calls to like, and what we envisage
in the intricate whirrings of the parietal lobe
may be late things, and mushy, phantoms only
to that rocky entablature at the root.

Note

Under the cerebral cortex in the human brain is the basal ganglia — an earlier, primitive structure inherited from reptiles that appeared 300 my. ago. Since the basal ganglia is intimately associated with brain functioning, indeed appears to be associated with feelings and intentions, our thinking, however sophisticated, has ancient roots. Reptiles of course are cold-blooded, and need to be warmed by the sun's rays before they become properly active.

26. The Oyster

And all most obviously in the oyster — today
Ostrea, but before Gryphea, Inoceramus:
many names but meaning a ridged outer
surface but inside a smooth-laid sanctimonious

whiteness of enamelling which also
encases the mantle, siphon and the cilia:
things morphogenic of the female regions
as to support, perhaps, their reputation.

Further than that it's not wise to take it.
The things are untidy — or must seem so to all
but white-coated doctors or diligent lovers
as things that hang out that should be held in.

But none of this matters to the mollusca as
in nacreous cavities they quietly filter
the nutrients from water. The tiny gills
are a flare in the water till the house clamps shut.

So this scatter of shells is not of passion
in species breeding, but a life thrown up.
In these crystalline waters each swelling muscle
was a focus of living, which now it's not.

Note

Oysters are very common lamellibranchs — a class of the mollusca — and can be found from the Ordovician onwards. Molluscs have a bivalved shell, a muscular foot and digestive tract. Commonly they live on algae, filtering food particles from the seawater by means of structures developed from the foot — a siphon and rows of filaments called cilia.

27. Dinosaurs

Then, distantly in my schooldays, they
were slow, ponderous, phlegmatic creatures,
floating and flaccid like the Diplodocus,
extended as a meniscus in a vague, wide dream.

That nonsense has gone now, what with books and feature
articles and museum visits. Seems
they hopped, sprung, flew, swam, sprinted:
got about as much as you or I.

So looking on these bony sockets, the heaped up
articulations of the pelvic region,
one senses something of a rapt explosion,
a building up silently through the sonic boom

that went on increasing through the accumulations
of magnesium and calcium, through to sober phosphates:
one with the cartilage in being brought,
reverberating, back to a mutual home.

Not, in its way, you may think, so different
from a later, neotic, much brain-addled creature
that must go on extracting from its own thin fibres
a firmament of filmy imagined things.

Note

Dinosaurs appeared in the Triassic and dominated the animal world for the succeeding 140 million years — far longer than man or even the mammals. Dinosaurs walked on land, swam in the sea and as dinosaur-like pterosaurs flew in the air. Most terrestrial dinosaurs could walk more or less upright on two legs. They were very varied: some like the Tyrannosaurus, were among the largest of all land animals; others were no larger than a lizard or chicken.

28. The First Mammals

So many in their class, order, families
have gone out and over and are extinct,
which makes it more likely that some small creature
is calculating how to do in us.

Could hardly avoid it. Remember that mammals
remained for the most part small rodent creatures,
underfoot animals when the dinosaurs ruled:
but as mammals got them, so this thing might us.

What thing? you say. We're not that stupid. Yes,
possibly some virus pandemic could
in theory bear us off before we knew it;
such things have happened and could so again.

Many scenarios, as far as cosmic germs,
but the culprit is likely to be simply us
who stagger about with our genetic revolvers
loaded against us like the sharpster's dice.

Why do we meddle and want to evacuate
what worked for many if not for us? Our world
would be simple if we only agreed. Yet
we can't and don't, and some small thing may know it.

Note

The earliest mammals appeared as shrew-like rodents in the Triassic and seem — as far as can be told from their rare remains — to have been coeval with dinosaurs for over a hundred million years. Mammals only came to prominence when the dinosaurs died out at the end of the Cretaceous, though they have since evolved into forms that dominate the land and appear in a few forms (whales and dolphins) in the sea. They never conquered the air, however, birds of course evolving from reptiles.

29. The Lower Lias

All these blue-grey and rhythmic alternations
of clays, marls, marly limestones which,
though thin as playing cards, are stacked in thousands
throughout England and Europe, and the whole wide world

we saw of course as simple oscillations
of the sea floor bottom, from shoal to swell.
And that was sensible — we couldn't scan
the bar-codes assembled in each seaside cliff.

No theory then for a continuum
of earth in an orbit far out and trembling
to a fall, and falling till the steady draw
of other planets in orbit pulled it back.

And so it continued, and is indeed recorded
intricately in each clay and lime
divisions that are fractal, always, and
exhibiting a randomness through every part.

Ruefully of course we can see it now:
the globe dependable but balancing
the hurt of heart-beat, and in hairline tremors
marked out in tide-lines of lime and mud.

Note

The Liassic rocks are alternations of blue-grey shales, clays and limestones that crop out on the Dorset and Yorkshire coasts and represent the oldest of Jurassic rocks in the UK Their very regular alternation of clay and lime was first interpreted as the results of periodic rise and fall of the seafloor, but seems more likely now to be caused by small perturbations in the earth's orbit.

30. The Cotswolds: Coral Limestones

Blue vales, ribbons of coloured hills — folly-crowned, contenting in themselves, but casting in their long, fluted cuervas the ripples from the continents plicating into Alpine Europe.

Yet that a long time after. Here the water-meadows, sturdy haze of thorn and alder, the great oaks, tall elms, a rural England quintessentially unflurried with its clocks

and calendars is underlain by rocks sedimenting out these drying seas: clear waters, corals, sunlight and warmth from a climate seasonal and close at hand.

And even if the water deepened, as it did, or shoaled on horsts and swells, accumulated sun-baked thicknesses of fetid mud, yet here was provenance, continual flooding

from a tropical landmass with no polar ice caps or tortuous desert scenes. No mountain building even, but only the quietly spoken of the decently prosperous and stay-at-home.

Note

The honey-coloured stones that are such a well-known feature of buildings in the Cotswolds and south Midlands are limestones and sandstones laid down in the middle Jurassic, at a time when much of Europe and elsewhere was covered by warm seas supporting corals and other reef animals. Conditions worldwide were generally peaceful, moreover, and there no major glaciations or mountain-building episodes. Afterwards, in the Tertiary, these rocks were thrown into the Alpine and other mountain chains, but these orogenies created only gentle folds and small faults in mainland England.

31. Ammonites

Members of the same class, the Cephalopoda, along with ammonoids and the belemnites: each was abruptly extinguished, but are co-resident with us and with the depths.

Curious therefore their best-known descendent — the Pearly Nautilus, with its iridescent, dawn-like shimmer as it drifts across whole oceans, or can do, is so whorled and thin.

More if we consider the petticoat delicacy of their luminescence in the sunlit mind, their lightness on dark in the accumulation of nacreous pieces in the stiff Gault Clay.

All are Mollusca only, remember, with a capacious, tough foot that grasped and fought. If you think of them moving as a vast suspension of residences in water through their tiny shells,

they are not rococo so much as protected in intricate septae beneath the spindled ribbing — by this more inscrutable, and indeed more brutal in purposes than ever the great Popes were.

Note

Ammonites are cephalopods, a class of molluscs that continue to this day in squids, cuttlefish, octopuses and the pearly nautilus. But ammonites were the most abundant and spectacularly successful order, developing a vast range of genera and species in the Jurassic and Cretaceous periods before dying out completely by the Tertiary. All cephalopods have modified their muscular foot into a siphon, through which they move by a sort of jet propulsion.

32. Wealden Ironstones

Small woods, half-timbered properties, long drives
to ponds, illuminated, where dimpled lawns
run up to sundial and to silver birch —
a rural Elysium that rolls its turf

on onetime furnaces. A good deal helped —
a land in trade, labour to buy, wood
to burn, and the small ironstones nodular
and plentiful as cowpats on the ground.

And so it went on till all shifted north:
from part-time industries with local men —
graziers, herdsmen, labourers — men content
to go on working where their forebears went.

In time that changed, and had to. In the great
rimmed cauldrons of the Pennine north, rough men,
who drudged and brooded, took the cropping out
of coal and ironstone as God's own work.

But here though never. No. Not mines or quarries,
just hammer ponds breathing with the passing clouds:
phosphorescence silvered with the summer days
that darken toward winter and the wealth to come.

Note

The earliest iron-working in England occurred in the Weald. Ironstones —clay-iron concretions in the Cretaceous clays — were dug out and smelted locally. Small lakes were dug to pond water that drove water-wheels, hammers and bellows, these 'hammer ponds' subsequently becoming ornamental features in the large estates of the stock-broker belt. In the late eighteenth century the industry of course shifted to central and northern England, where coal and thicker beds of ironstone fuelled the Industrial Revolution.

33. Fuller's Earth

Being used to cleanse and to thicken cloth,
these soft brown clays were dug around the place
in pits once small, but down the generations
merged to quarries of the large consortia.

When lo! quite magically, this fuller's earth —
an ash in fact, and ancient — plumed from vents
perhaps not far away but never found —
assumed a further and more radiant use,

at least with ingenious chemists helping. Yes,
a major export-earner, source of cash-
flow used to balance books, erect the boards
that stare down blankly from these office blocks

on cars and shopping precincts, on the side-
walks tiled with brick and other products — a lush,
beyond commuter-land, of private schools,
smart cocktail circuits and of point to point.

So earth becomes what it had started from,
gentle eruptions out of a Green-Belt land:
first a pumice in the air and then
a fining and a bedding smoothly down.

Note

Fullers earth is ancient volcanic ash that appears as lenses in the Cretaceous rocks south of London. It has been used since medieval times to clean and thicken cloth. For many centuries the deposits were worked on a local scale, but small workings were amalgamated in the twentieth century when companies realised such industrial minerals could be refined and extended in their uses to become major profit earners.

34. The English Downlands: Chalk

It may be this, above all, which so eludes us:
a shoreline forever receding, at last to merge
with a flat land, a clean land, as the coccoliths
rained down in their millions to bedded Chalk.

Above it the wind, on the high Downland ways,
flattens the grass or sets the harebell nodding,
as though it would breathe through the innocence
of the airy, thin skeletons that form this rock.

Yet here it all ended, the great mass-extinction
of the Mesozoic in this crumbly almost nothing.
Occasionally a plesiosaur is found but mostly
it's shark's tooth, a coral, an echinoderm.

So the asteroid winter, whatever it was,
is hardly recorded, and the dinosaurs
drifting, asphyxiated, would have dissolved
just as they were into this new beginning.

Perhaps it's this that we encounter at Eastbourne
where the white cliffs fall into the summer sea:
an abrupt clean ending, and a placenta severed
from a continuum of childhood we have lost.

Note

Chalk is a thick white limestone formed of grains of calcium carbonate and the shells of marine algae (coccoliths). The sea in which the limestones accumulated was fairly deep but very clear, extending a vast distance over Europe, from Russia to Ireland. The Chalk in England is the last deposit of the Cretaceous, i.e. before the Tertiary when mammals replaced dinosaurs and finally evolved into primates and man.

35. Echinoderms

Providential, when each Sunday walk, brisk
along the esplanade or shingly beach,
brought in such numbers of these creatures, cast
in flint or calcite from the gleaming Chalk.

Echinoderms, the lot of them, but also
bit by bit more heart-shaped — changing, in a
word, evolving, that was it, as Darwin said —
and all quite beautiful when taken out.

On the upper surface and the grooves leading
immodestly to mouth and anal sphincter
one could see the plates knitting and diminishing
like little girls' pudenda, scrubbed and neat.

Which charms they show today, if claimed from vaults,
retrieved in their hundreds from the prurience
of moralists who measured up by the size
of breast or genitals the descent from God.

And odd, particularly, that these small creatures
decked out in thin white sutured shells, became
a frisson for old reverent gentlemen, with flocks
of women following but never kissed.

Note

Geology was a fashionable pursuit for the middle classes in the late nineteenth century, and vast collections were built up of local fossils — most notably of ammonites from Dorset, and echinoderms sea-urchins) from the Kent and Sussex coasts. The echinoderms are of several genera, but all evolved upwards, allowing the chalk thicknesses to be divided into fossil layers or time zones.

36. Basalts

Around and — more pertinently — beneath, they rise
beneath the depths and are unknown unless
they set in columns as at Fingals Cave,
or roar, with violence, out of Vulcan's lair.

But think how widespread they are still,
how invidious their fluids that may filter through
the one thing continued through the life of man —
the moving continents beneath his feet.

Yes, there are shocks, movements, upheavals, say
the bespectacled seismologists mildly
extrapolating from routine, almost friendly
graphs, that threaten oblivion, however unlikely.

No: subducted and smoothly drawn away
go all the seabed limestones, sands and clays —
compacted, melting and, before our eyes,
erupting out into cooling lava again.

The point of it? I hardly think there's one.
Except to say in coalescing: mixing
earth's deep fluids, melt and gas, the basalts
show us vulnerable to each new attack.

Note

Basalt is the commonest igneous (fire-formed) rock of the earth's upper crust. The rock underlies the oceans and the floating continents. As its fine-grained nature indicates, basalts cooled quickly, and occur commonly in lava flows and small igneous intrusions.

37. The Isle of Wight: Gastropods

Of course, in winter, down comes the rain, just
as pitiless as elsewhere, bleak and thin,
up-ending the streets with their spindled people, beyond
the conservatory-rooms with all mod cons.

But still there was always something I thought tropical
about the surroundings, the country, the comfortable bodies,
the skin creamed and pampered beneath warm blouses,
skirts and lingerie from BHS.

It's this which comes to mind in the shells washed down
from Miocene or Oligocene accumulations:
gastropods mostly, intricate twistings
that ended in an opening flared-out and chaste.

Both somehow together, as Boucher depicted
who collected such things, I remember, liking
how their dormitory and muted exteriors hid
the most voluptuous of windings when you looked.

So that behind them, as behind all the bungalow lives,
meeting the bills and the morning paper, is a
holiday loucheness or moral vagrancy
whorled and folded in each nacreous shift.

Note

Gastropods are snail-like shells, and form another class of the successful mollusca. Though gastropods go back to the Palaeozoic, they became especially abundant in the sub-tropical Oligocene and Miocene (Tertiary) rocks of the Isle of Wight and adjoining Hampshire basin. Many are beautifully preserved, and still retain their pearly lustre and bright colours.

38. Flowering Plants

Though every gardener knows how particular
as to soil-type, and water or sun they are,
plants on the whole flower, leaf and fade
without much emotion: they're never made

angry by a clematis planted in some lime-poor
spot, nor bring no demo to your door.

Roses unpruned, or flowerbeds with weeds,
are solecisms more, like slacks or tweeds

at the first day of Ascot, or being the guest
who forgets he must follow, leaves after the rest.

And walking at length about any house
grand or suburban will find some mouse

of forget-me-not, snapdragon, love in a mist —
things that are best when untended, simply left
to be themselves, that's with their perfumes drawn
from the frank and neighbouring mulch and loam.

But essential and homely, as if meant to show
by their rootedness how our own lives grow:
always daily at evening, over warm twinkling grass,
runs the mower, click, click, as dynasties pass.

Note

Flowering plants appeared in the Cretaceous period some 120 million years ago but had expanded by the Tertiary to make up ninety percent of all living plants, from tiny duckweeds to 100 meter-high eucalyptus trees.

39. The London Clay

Firstly the stuff that the capital is built on,
these plain, unconscionably stiff brown clays.
In fact they are blue when first dug out but on
weathering become this dull as unsweetened fudge.

But useful, were so rather — pits are gone —
for making the carapaces regimented
in deep reds, burnt purples, buff-ochre yellows —
in these the cheapest of suburban rows.

But there is more. As the districts spread,
from select to tawdry as the fashions altered,
the clays spread out also, and on afternoons
glaucous as this they are still confining.

Dust into dust? No, these tenements are
more than our lifetimes encased in clay.
and what they hold up is not a featureless daub
but something of sunlight, the seasons and life.

And still there is something, if no aroma
of palm tree beaches or of nipa swamps:
redolent of warmth and tropic blues
behind these tenements of household brick.

Note

The London Clay is a several-hundred-feet thick, tough, blue-grey clay of Eocene age found in the London and Paris basins. The clay weathers to brown, and is usually unfossiliferous. But in a few localities the clay discloses evidence of a subtropical climate — shark's teeth, the bones of alligators and fragments of fruit and palm leaves. Formerly the clay was worked in large brick-pits, sand being mixed with the clay and often poorly fired to give the greyish-red, yellowish or purple bricks which feature so prominently in cheaper London dwellings.

40. Shark's Teeth

Not bone but hard, almost mineral-like,
stronger than silicates, and gleaming right
down to the groove in the packed enamel
that conjures up shadows from the sunless depths.

Such then the rosaries of the mountainous sharks
with bodies like liners, enormous, sliding away
till all that remained were the packed rows of teeth
and tug of dorsal through those dangerous seas.

Immense as that energy was in tensed muscle and tendon,
the cartilage, rotting, would leave no trace —
nothing at all — but apt, on reflection, as sharks
at these depths were a blood gasp and gone.

Often abundant, indeed in countless thousands,
are the teeth that pierce through like thorny needles,
or punch their way in, round phallic blades,
or grinders or shearers, of all motions and grades.

But whatever their groupings, or supposed descents,
and closely indentured, they can end in nothing.
Like a blind shoot thrust up from our shadowed past
we hold them in wonder and let them drop.

Note

Sharks probably evolved from placoderms some 390 mybp. They do not have a bony skeleton but gristly cartilage that rots away and is rarely fossilised. What are found, and often in huge numbers, are the teeth, as these were regularly replaced and strongly constructed of dentine and enamel. Some extinct sharks were enormous — several times the size of our modern great white.

41. The Nematodes

Not among the best loved are the nematodes: worms that are tenacious, with a pencil vision, grasping and piercing, always probing and leaving only their castings, unless of course muds

were exceptional in sticking and sealing them off. In the past, abundant — and are so in waters, in the soils, in vegetation, the interior parts of mammals like us, as all too often and

memorably still the photos can show them. A slice is cut through, and the cavernous brain is crawling with these things, feasting and thrusting to emerge at the orifices, plump and sleek.

Of course mindless and stupid. They certainly kill themselves and their host by their fat indulgence. Moreover their nastiness is not in fact even an exemplar of programmed greed.

For, however we may view that perfect world of Plato's without these complications of teeth, tracts and muscles, these grim worms are next to semi-chordates, to mammals, and so to us.

Note

Nematodes are one of three phyla of worms - animals that reach back to the Proterozoic era. Though a simple organism, worms are generally regarded as the ancestral to semi-chordates, and so to the vertebrates, including man eventually.

42. Birds

To do bird is to do time, of course, and these
collecting on rooftops or suburban parks
are not so much yielding to the wide air round
as fending off purposes in that first start.

The which they have come from, their whole life one
of aspiring like Icarus to escape the earth,
leaving both gravity and their entrapping shape
in the long phylogenies out of which they're built.

All of it pointless. Their trajectories point
to a tough skin, thick scales and developing beak
and then there were feathers, and their sharp round eyes
grew unblinking as drones that must stalk their prey.
Even their flight — if you watch — is not of grace
but a run, a plunge, a fierce explosion

as the joints knit, the heart pumps, and the long wings spread,
pterodactyl-like on extended air,
outwards, away from them, till they leave that past
as an odd spot of shadow that lifts away.
They rise, diminishing into the sunlit sky:
reptilian, light-bodied, and headed back.

Note

Birds are warm-blooded animals that appear to have evolved from reptiles, possibly from tiny dinosaurs like *Compsognathus*. Birds are rarely preserved, and the earliest European fossil is the late Jurassic *Archaeopteryx* from Bavaria: with feathers, a long bony tail and teeth in its jaws. Other birds are known from the Cretaceous of north America, but the record is sparse until the middle Tertiary.

43. Tertiary Carnivores

We have seen them; they have come again
with their tusks and their grinding mills of teeth:
evolving, furiously, and still more fastened
on their hosts, as passengers, to feast and die.

Symbiotic, the lot them, being linked
as tapeworm through pig to a human host.
(One with appetite in its thick loops of feeding
the other not latched on, or even seeing

how each must attenuate and drop away,
that the eggs will find others, and so the pig.)
Yes, they will pass, and their place be taken
as an omphalos turning with tail in mouth.

So the old world saw it, knowing man
to be a carnivore-savant, both butcher and saint:
such conflicts inside were the authentic nature
to be guarded against, retrieved and watched.

Perhaps that is sensible. In the tumbrel of life
first-hand they knew how near to extinction they came.
Cubs can play meekly in the long-tailed sun,
but carefully the ruminants protect their young.

Note

The north American sabre-toothed tiger is probably the best-known of the Tertiary carnivore. Its great teeth evolved to puncture the hides of the large herbivores on which it fed, naturally following them into extinction as herbivore foodstuffs disappeared with change of climate. There were other carnivores in the Tertiary, many much more spectacular than the sabre-toothed tiger, but their fortunes were equally bound up with those of their prey.

44. Ants

Forget not their toil, unceasing, and do not pass them by contemptuously, for these small creatures take concrete to pieces, and can from vents pile silica about them as soon as breathe.

More numerous, industrious and self-effacing is the dust that's also drudging about, now drifting and rasping and making projections uneventful and polished as the practised ants.

What hope for the high in the small things breeding when each will take something and put nothing back? The ziggurat, the forum, and the acropolis first fall to tribesmen, to tourists, and then to dust.

In which there are potencies all the same for adventure, ambition, for setting forth. The insect, the virus, and the mere bacterium are dispersing the codes from which all is built.

And so we say yes, approving the change so as not to be buried by assembled things: only warfare continues, and here on earth are these chitinous divisions that bristle forth.

Note

Ants are insects (arthropods) with a highly developed social skills. They are known from the middle Palaeozoic onwards.

45. Early Man

Savannahs bred them and the hot sun clothed:
in thickets they lived or in waving grass,
not monkeys or baboons, but a link between —
the gap that begot them went seriously wrong.

Didn't it ever? Yet they scratched a living
from tree-roots and berries, from the ground in hunting.
Anything or nothing — not over-adapted —
they trooped and contested: were a thorough nuisance

what with chattering, gesticulating, making
whole nations when families were the usual thing.
They connived, cheated, in the end made traps,
constructing from others what they did not have.

Great babies, moreover, could hardly walk
for the first year or so, and then not far.
Needed pretorian guardians all their lives,
were instinctively furtive, afraid of the dark.

Which they knew and resented: made others play
the games they controlled as they went along.
None of the animals were their extended kin
but were cajoled and persuaded by their self-styled king.

Note

The higher primates seem to have originated in the savannah lands of Africa some 4.5 mybp, perhaps in the great rift valleys that offered was abundant water and game. Early remains are few and fragmentary, and the descent is not exactly known. But from one or more species of Australopithecus probably came Homo habilis, Homo erectus and finally Homo sapiens. Man is unusual among animals in that its juvenile stage is very extended, calling for a long period of guidance and nurture — which no doubt lies at the roots of its social nature.

46. The Thames Valley: Mammoths

Swollen as they are and part of earth-time, the tusks,
femurs and molars — huddled together in fissures,
in long loams, in gravels well-pummelled — canticles
of enamel moving with the rivers that brought them,

grinding south and south, with the ice-blocks floating:
the auroras of winter canopied in their small brains,
the husks no doubt also of summer in their soft hides,
only we cannot see them, all that hugeness gone

greedily but without stain into the heavy tills —
the Gipping, the Chiltern, the Lowestoft drift:
tough, glutinous blanketings that the great bones
work in and founder, and are never released from.

For imponderably they are of this time and this place,
uncomfortable or diminishing as that may be,
in docks or foundations of industrial buildings,
things that are nondescript but carefully planned.

As such these pantechnicons of the flood,
ruminating and then melting into the tundra,
may almost be part of our own tenured lives,
integral with the weather in this late warm spell.

Note

Mammoths appeared in Africa about 5 mybp, spread into the northern hemisphere, gave rise to modern elephants and then died out. The best known species is probably the woolly mammoth which ranged north of the Arctic Circle. It stood nearly ten feet tall and had tusks that curved backwards.

47. Cave Men

The residues are what one thinks of — the red stuff caking the bones, tusks, sharp rows of teeth of the bear, hyena, wolf and lion — all jumbled together as a cave detritus.

Matted, I should say, with a fat residuum of limestone that gradually was leached away into piteous yawnings, bottomless chambers — for days they went on but still darkness grew on the plains, in high grass or hiding in thickets. Though seasons went criss-cross as tracks in sand they could feel the memories of another winter, a landscaped carved out of a brutal ice.

So even to stalk, catch, stampede or kill them wasn't sufficient, or even consume them. Fat roared in the flame, the carcasses opened, but spirit as a life force leaked away.

And must be brought back, into deep interiors, sketched on high walls in an outline soot. There they would watch, as over winter's lengthening the skulls of their fathers rose large and still.

Note

Human remains are comparatively rare, but occur in cave deposits with the bones of cave bear, elk, lion, mammoth, rhinoceros — depending of course on the climate at the time. The red clays in which they are found are the residues of the limestone, dissolved out by percolating ground waters. The cave paintings, usually located in the deep recesses of the cave system, served religious or magical purposes that can only be guessed at now.

48. Snowdonia: Ice

On mountains, shelving, and on standing lakes,
a stunning whiteness and then a bitter frost
in a land of moraines, drumlins, eskers that lay
beneath all the summer, and in cold about —

which still would come back, blundering on
into glaciers, whiteouts, shrouded mammoths, bear,
till distally and signally the melts trailed out
to conifers, to poplars and then temperate grasses.

And a gradual heritage for hunters-gatherers
in a landscape smoothed out, or with pocket hollows —
round which they farmed, fished, till they half-filled them in,
what with the climate supporting and the ample soil.

But not in the end: there were always the torpors
when cirques returned, half, to their former state.
The cold made patterns and the hoar frost deepened;
the mountains tinkled crisply in the bare-rock steeps.

But more of that even in their inner natures,
their fastness of being, to the very bones
came the eloquent and empty white of winter
till the summertime trampled them to loams.

Note

In the passage of rain, ice and rivers, the landscape is continually shaped by the elements. But during the last two million years of the Pleistocene period, Europe was several times invaded by great ice sheets that dammed or diverted rivers, cut U-shaped valleys in upland regions and spread great thicknesses of moraine and outwash material over England north of the Thames. In these areas lived *Homo sapiens* — hunting animals across the savannahs of the interglacial episodes and retreating to caves when the ice-sheets spread south again.

49. Winds

They come, unwinding from the earth's long axis
in consort with weather and the moody heavens,
bringing the seasons and their dispensations
to plant in the bountiful and seamy earth.

For winds in truth have innumerable particles
of soot and dust and sulphur, also water-
vapour, seeds, spores — millions upon millions
of startings that weave around us the flux of life.

And this perhaps is what our bodies know
in more than simple action of the lungs —
inhaling and suspiring that our inner ways
will burst with the seed pods of wind's corpuscles.

A moving and a matching — the more so on days
when wind exults in its purpose, and the driving force
drills through our faces, as though inflating the skin
with a wild importuning to be given and lost.

The leaves hard-straining, as the branches too
inflect quite away from any earth-bound state,
we also unravel into innermost longings,
to stream out in plenty to our own far place.

Note

Winds are among the most important but overlooked of nature's forces. Storms and hurricanes bring devastation and great loss of life. But the more gentle winds also carry seeds, spores, germs over vast distances, starting and encouraging plant life, controlling the migration patterns of animals, and giving to man the means of navigating oceans after new markets and commodities.

We Humans

And so we come towards the end, from hut
to tower and temple, court, the masque of music,
the learning of the stars, and all this pulsing
from us, building to a larger place.

What is it that concerns us? Why do we reach
beyond what offers us our wealth and home?
If we are animals why do our hands
respond to concepts that are only air?

Intangibles, imaginings, the myriad thoughts
that crowd within us in a single hour:
these are our links, our kinships, our things beyond
all technicalities of new-age priests.

What wonder is it that the wayward god
be hardly shining in us, almost gone?
And only is of a dull grey matter settling
out from certainties to faltering sight?

All these are ours, and were and will be — all
that's in bodies lengthening out of all that was.
This our patrimony in the guise of wanting,
informing our dreaming and thinking and going on.