Liquid Life
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Part V

BEING
LIQUID APPARATUS

‘Beings in transition’ are agents of discovery that take the form of lifelike droplets, which interrogate the theory, qualities, characteristics, and apparatuses of liquid life. In this chapter, an account of the Bütschli system is given, based on the study of dynamic droplets under a light microscope, which provides fourteen phenomena associated with various stages of Bütschli droplet development. These act as a language, or ‘angelology’ for liquid life, through which its imaginary and technical capacities are developed. Quotations from a variety of sources are juxtaposed with experimental accounts to introduce ‘quality of living’ into design-led observations, where chemical events acquire a specific cultural context. These provocations lay the foundations for poetic experiments by Rolf Hughes in chapter 10, and notations by Simone Ferracina in chapter 11.
Lively Liquid

... like the sceptics of atomism who could see no way of verifying the totally invisible or the ancients for whom the stuff of the stars was unknowable; or Mendel himself who did not believe that the material basis of heredity would ever be discovered. Not being able to see experimental approaches is part of the paucity of the imagination. (Cairns-Smith 1987, 135)

Liquid technologies are not constrained by or translated into the operational structure of the machine, but retain the potential to create transformative events, experiences, and habitats. The strangest and most creative of these is the Bütschli system, which establishes a unique dialogue with the living realm, by providing access to a realm of low-level ‘agentised’ material operations that inhabit fields, interfaces, and protean bodies that continually respond to their environment. While it is evaluated through the specificity of these encounters, being concerned with ‘this’ particular molecule, or ‘these’ specific qualities, in ‘that’ precise place, its operations are very different to the kind of push-button or touch interface that has been developed for machines.

Arising from the edge of chaos, Bütschli droplets take their first rebellious steps against inertia through the stages of birth, life, and death (Armstrong 2015, 87). Moving through lifelike transitional states of existence, they splinter away from their initiating field of organisation, in material expressions that range from simple droplets to structured configurations and population-scale assemblages. Embodying an explosion of proto-Cambrian chemical diversity, they offer a glimpse into the parallel world of liquid life.

At ×10 magnification, radiant aqueous bodies cast shadows on a dark oil background with their turbid trails of osmotic structures formed by soap precipitates. At ×40, the narrow field of view reduces the field contrast and the droplets appear like wraiths, which grow scaly skins against a slate background.
Around 80% of the initial droplets rapidly develop thick encasings that form deposits on the base of the Petri dish like chemical snow. While many perish in the initial stages of this journey, some prevail and persist, becoming increasingly organised. Some break free to reach the container’s edge, where they turn back in upon themselves to traverse liquid fields that are contaminated, or ‘structured’, by their own waste products. Others circle in groups where they steadily increase in mass through the production of deposits and become tethered to the bottom of the Petri dish, where they strain restlessly against their moorings. Those that do not ‘perish’, steadily accumulate soft deposits, or ‘osmotic structures’, at their interface that eventually prevent the droplets from ‘feeding’. Encased in their soapy cocoons, these droplets eventually reach a tipping point in their thermodynamic order and plummet towards thermodynamic equilibrium, or ‘death’.

Osmotic growths like living things may be said to have an evolutionary existence, the analogy holding good down to the smallest detail. In their early youth, at the beginning of life, the phenomena of exchange, of growth, and of organization are very intense. As they grow older, these exchanges gradually slow down, and growth is arrested. With age the exchanges still continue, but more slowly, and these then gradually fail and are finally completely arrested. The osmotic growth is dead, and little by little it decays, losing its structure and its form. (Leduc 1911, 151)

In an open environment and over the course of billions of years, such agile tactics may ultimately increase the material complexity and fertility of a site, or even generate discernible signs of ‘alternative’ lifeforms.
Life Cycle

Our home was a split-level affair with 14 steps leading up from the garage to the kitchen door. Those steps were a gage of life. They were my yardstick, my challenge to continue living. I felt that if the day arrived when I was unable to lift one foot up one step and then drag the other painfully after it — repeating the process 14 times until, utterly spent, I could be through — I could then admit defeat and lie down and die. (Canfield and Hansen 2012, 246)

Standing in for the qualities neglected by classical expectations of the material realm, in these experiments Bütschli droplets are granted the mythological status of angels, which are explored through fourteen ‘key stations’ that take place within a theatre of chemical events. Each title refers to formal classifications made to the characteristic behaviours of the system, which I have previously published in *Vibrant Architecture: Matter as CoDesigner of Living Structures* (Armstrong 2015). References to themes relating to the process of ‘living’ are mixed into the experimental observations, to emphasise the ethical dimension of the lively material realm and to render it strange. Selected quotations conjure forth experiences and expectations that exceed functionalist Enlightenment narratives, which typically frame experimental findings.

As messengers (information), vectors (direction), translators of events (transformers), messages (language) and things-in-themselves, the Bütschli angels brought forth by the mixing of alkali and oil, draw our attention to the extraordinary characteristics of matter at far-from-equilibrium states. In the following design-led experiments and alternative spaces for dreaming and transformation, they seek to (re)unite the soul substance with the material realm, so that the remarkable char-

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2 Each quotations indicates the specific characteristics of a particular Bütschli angel.
acteristics of the living realm may be observed anew through the lens of liquid life.
Birth: Field of Fire and Ice

The little fires spawned by each four-pound incendiary ball joined into middling fires, and middling fires into bigger fires. Soon, the fire whirls were self-sustaining, sucking in oxygen from all around and creating intense cyclonic winds. Gale force winds spun into the centre of the fires, sucking combustibles, animals, bricks, beams, and people into the maelstrom. The asphalt in the streets turned to molten black rivers. In the superheated air, people asphyxiated or died from breathing the hot gases. Structures apparently far from the fire front would suddenly burst into flames. (Logan 2012, 166)

When the alkaline droplet first breaks up in the oil field through the saponification process, it self-organises into a polarised, dynamic field with a characteristically arched, rolling front. This moves outwards, producing ripples with a flame-like appearance. Soap flakes, like ice crystals, are swept backwards and accumulate at its trailing edge, where they begin to form osmotic structures. In this initial highly energised stage, the front can break up into discreet bodies that resemble moving islands of ‘fire and ice’.
09.2.2

Birth: Shells

If what you found was made from pure matter, it will never spoil. And you can come back one day. If it was just one moment of light, like the explosion of a star, you will find nothing on your return. But you would have seen an explosion of light. And that alone would already be worth the journey. (Coelho 1993, 118)

As the alkaline field continues to break up, twisting shell-like structures appear, which absorb energy from the environment to remain stable.

Like tornadoes trapped within tiny Russian matryoshka dolls, these turbulent manifolds burst out of each other, time and time again. Many suddenly collapse on their release and form dense crystalline deposits, while others enter a new phase of organisation as lifelike droplets.
Life: Organising Droplets

... Some sat
Poised like mud grenades, their blunt heads farting.
I sickened, turned, and ran. The great slime kings
Were gathered there for vengeance and I knew
That if I dipped my hand the spawn would clutch it.
(Heaney 2002, 4)

The chemical front disintegrates to become wandering fields of dynamic droplets. Some move alone, while others form groups that explore and modify their surroundings by casting complex structures from around their posterior pole.

As if out of a witch’s cauldron, a parade of forms arises from the conjunction between liquid media; tadpole tails, rose-like formations, knotted rhizomes, and winking encrustations.
Fourteen Liquid Stations of Life: Primary Morphologies

... they were words
invented to define things
that existed
or did not exist
in the face of
the pressing urgency
of a need ...
(Artaud 1975)

The configurations of Bütschli angels are not pre-determined, or gradual, but are continually negotiated through their exquisite responsiveness to instabilities and ability to rapidly transform in response to change.

The ensuing interdigitations, cohesions, dissolutions, extrusions, and inevitable collapses in the following sections, map a pathway of entropic resistance that shapes the character of liquid life.
Life and death appeared to me ideal bounds, which I should first break through, and pour a torrent of light into our dark world. A new species would bless me as its creator and source; many happy and excellent natures would owe their being to me. No father could claim the gratitude of his child so completely as I should deserve theirs. Pursuing these reflections, I thought that if I could bestow animation upon lifeless matter, I might in process of time (although I now found it impossible) renew life where death had apparently devoted the body to corruption. (Shelley 2014, 44)

Bütschli angels wander flâneur-like in search of the path of greatest resistance towards their inevitable end. Leaving chemical ripples in their wake, they surf the forward progression of time, which shapes the irreversibility and creativity of liquid life.
09.2.3.1.2

TWO Life:*Osmotic Skin

... true theatre, because it moves and makes use of living instruments, goes on stirring up shadows, which life endlessly stumbles along. (Artaud 2010, 7)

Soap crystals that arise from the meeting of alkali and oil are carried upon miniature glacial flows that clothe the Bütschli angel's body. These osmotic skins may take on the form of undulating jellyfish, stuttering werewolves, or writhing worms, and break away from the droplet body, to archive the metabolic intensity of the system as soft fossil trails.
THREE Life:*Clusters

He sees efflorescences in fragments of ice, imprints of shrubs and shells — yet so that one cannot detect whether they be imprints only, or the things themselves. Diamonds gleam like eyes: metals palpitate. And all fear has departed from him! He throws himself down upon the ground, and leaning upon his elbows watches breathlessly. Insects that have no stomachs persistently eat: withered ferns bloom again and reflower; absent members grow again. At last he perceives tiny globular masses, no larger than pinheads, with cilia all round them. They are agitated with a vibratite motion. (Flaubert 2005, 190)

As Bütschli angels pattern their surroundings, they avoid the trails of their own waste products. Their aversion is such that while circling, they may become paralysed if they find themselves suddenly surrounded by a field of their own excrements. These invisibly scarred terrains provoke sudden actions, where chemical insect swarms weave over and around fossilised bodies, like pollinating bees. They shake, zigzag, and crash into each other in a frenzy of information exchange.
‘This is Hell,’ she said with a smile. ‘But Hell is merely a form of terminology. Really this is the Womb of the World whence all things come.’ (Carrington 2005, 137)

Bütschli angels inhabit an oily realm of constant instabilities, uncertainties, and displacements. Consuming the fuel within their own bodies they remain lively until they reach a threshold where they are either incarcerated in their waste, or have consumed themselves entirely. This auto-cannibalism is the source of their liveliness, which fuels a highly agentised material realm that only monsters truly understand.
FOUR Life:*Rose

In the transformative realm these practices … show a certain control of the transformation of individuals and their disintegration into a non-individual ‘body’ of skulls and long bones … the disordering of the corpse, the relocation and redistribution of body parts also can be interpreted as serving as mnemonic practice, creating and maintaining memories … bodies and objects do not belong to an individual but the community. Fragments of a body need not commemorate individuals … the politics of separating, giving and consuming [are] community concerns. (Gramsch 2013, 464–65)

When Bütschli angels become tired of osculating with each other, their bodies grow feathery crystals although they do not take flight, but fall. The fallen bones of Bütschli angels form structured landscapes that signpost alternative futures for beings yet-to-come.
FIVE Life:*Werewolf

Wide shoulders, long arms and she sleeps succinctly curled into a ball as if she were cradling her spine in her tail. Nothing about her is human except that she is not a wolf; it is as if the fur she thought she wore had melted into her skin and become part of it, although it does not exist. Like the wild beasts, she lives without a future. She inhabits only the present tense, a fugue of the continuous, a world of sensual immediacy as without hope as it is without despair. (Carter 2006, 141)

When the surface area-to-volume ratio of a Bütschli angel is optimised, it vigorously consumes itself and its surroundings. Heralded by the rapid precipitation of hairy crystals over its body, the drag produced by these uneven deposits causes the angel to move erratically. As these hair residues rapidly build up, the angel seems to grow a ‘tail’. The combination of profuse crystallisation and erratic movement is recognised as the ‘werewolf moment’, which precedes an imminent phase change in fate and behaviour. As more fur builds up around its body, the angel’s metabolism is weakened and heralds its inevitable decay.
Tucked darkly in their calciferous shells, listening warily for dangers, breathing oxygen into the water, sifting the silt, changing sex, the oyster has witnessed all our histories, all our struggles ... The oyster was here before we were. Before once upon a time. Before, you might say, time itself. Back then oyster reefs encircled the continents, a great shelf or ledge between the ocean and the land that we used to haul ourselves up or along, whichever it was, and row ourselves around this planet, cove to cove, not cavemen but covemen. Take one in your hand, feel the scratch of the shell of what we now call rock, prise it apart and you have Mother Earth’s chronicle of the planet and a taste of the future. Treat it with respect. (Smith 2015, 9)

When the skin of an angel becomes sufficiently thick and heavy, it no longer glides through the liquid medium. Its body becomes anchored to the ground, whereupon it continues to grow a thick shell like an oyster, creatures that were once considered only a little more sophisticated than minerals in the hierarchy of life.

Like beating hearts, the soft matter of angels keeps mark of subjective time through their iterations. Slowly consuming and incarcerating themselves in their waste products, their metabolism slows down to the point where they are barely breathing.
SEVEN Life:*Suckling Pigs

Of all the delicacies in the whole mundus edibilis, I will maintain it to be the most delicate — princeps obsoniorum. I speak not of your grown porkers — things between pig and pork — those hobbydehoys — but a young and tender suckling — under a moon old — guiltless as yet of the sty — with no original speck of the amor immunditiae, the hereditary failing of the first parent, yet manifest — his voice as yet not broken, but something between a childish treble, and a grumble — the mild forerunner, or praeludium, of a grunt. He must be roasted. I am not ignorant that our ancestors ate them seethed, or boiled — but what a sacrifice of the exterior tegument! (Lamb 2011, 6)

The active interfaces of incarcerated Bütschli angels attract the attentions of other bodies that circle around them, becoming their satellites. Such compulsions develop complex relationships, which may adopt formations that are evocative of suckling pigs on a sow. It is unclear exactly what draws these droplets together without fusion. One possibility is that it is surface tension-related, where glycerol, a waste product of saponification, lowers surface tension and invites other droplets to move towards each other.

Without Contraries is no progression. Attraction and Repulsion, Reason and Energy, Love and Hater, are necessary to Human existence. From these contraries spring what the religious call Good and Evil. Good is the passive that obeys Reason. Evil is the active springing from Energy. (Blake 1975, 7–8)

A reduction in surface tension does not explain, however, why droplets are repelled at the boundary interface and, mostly, do
not merge. Whatever the nature of the exchanged forces, a complex choreography of attractive and repulsive forces is at work.

When surface charge-based systems, like surfactants and salts, are applied to the surface of a different species of dynamic oil droplets, they can be induced to perform the kinds of physical movements associated with classical life cycles. Adding surfactants to the medium provokes droplets to divide, while adding salt makes individual droplets fuse. By alternating fission and fusion, the life cycle can be provoked to continue indefinitely (Marshall 2013, 7). Yet, this is simply mimicry of processes that operate a much higher organisational order than droplet systems, and without an internal or environmental system to precipitate these events, these experiments are cosmetic simulacra of living things without the unruly agency that is characteristic of lifelike systems.
Fourteen Liquid Stations of Life: 
Primary Behaviours

Trickster … is a pore-seeker. He keeps a sharp eye out for naturally occurring opportunities and creates the ad hoc when they do not occur by themselves. (Hyde and Chabon 2010, 47)

Bütschli droplets exhibit an opportunistic spectrum of distinctive types and tendencies. Such characteristics can be thought of as primary behaviours, which possess recognisable, although never exactly repeatable, stories.
Interfacing

Moon-milk was very thick, like a kind of cream cheese. It formed in the crevices between one scale and the next, through the fermentation of various bodies and substances of terrestrial origin which had flow up from the prairies and forests and lakes, as the Moon sailed over them. It was composed chiefly of vegetal juices, tadpoles, bitumen, lentils, honey, starch crystals, sturgeon eggs, moulds, pollens, gelatinous matter, worms, resins, pepper, mineral salts, combustion residue. (Calvino 2002, 6)

While Bütschli angels are attracted to each other, they do not usually fuse when they met. The distribution of water within their bodies can be observed by adding a hydrophilic dye under a fluorescence microscope. Glowing like tiny moons, the indentations of their soap scales can be seen as impact craters over the angel’s smooth surface. Using this imaging technique, Bütschli droplets can be seen releasing small jets of fluid into an adjacent body as their interfaces touch, but still, they will not fuse.
EIGHT Life:*Mirroring

Mirror-image identical
Twins. One egg, one sperm,
One zygote, divided
Sharing one complete
Set of genetic markers.

One egg, one sperm.
One being, split in two.

And how many souls?
… might the soul clone itself,
create a perfect imitation
of something yet to be
defined? In this way,
can a reflection be altered?
… do twins begin in the womb?
Or in a better place?
(Hopkins 2008, 1–3)

When a deep split occurs in the generative streams that produce Bütschli angels, mirrored beings emerge (Golbin et al. 1993). As in the case of biological systems, where identical twins replicate a shared fundamental structure, mirrored angels demonstrate commonalities, like form or behaviour. This is not a superficial finding but evidences the fundamental role played by propagative systems in the genesis of liquid life.
NINE Life:* Satellite

Not a few worlds were destroyed by the downfall of a satellite. The lesser body, ploughing its way, age after age, through the extremely rarefied but omnipresent cloud of free atoms in interstellar space, would lose momentum. Its orbit would contract, at first slowly, then rapidly. It would set up prodigious tide in the oceans of the larger body, and drown much of its civilization. Later, through the increasing stress of the planet’s attraction, the great moon would begin to disintegrate. First it would cast its ocean in a deluge on men’s heads, then its mountains, and the titanic and fiery fragments of its core. If in none of these manners came the end of the world then inevitably, though perhaps not till the latter days of the galaxy, it must come in another way. The planet’s own orbit, fatally contracting, must bring every world at last so close to its sun that conditions must pass beyond the limit of life’s adaptability, and age by age all living things must be parched to death and roasted. (Stapledon 1999, 88)

As large Bütschli angels produce more chemical attractants than smaller ones, they tend to draw them towards their orbit. Oscillations between the large and small angel bodies, result in tides of exchange that result in the mutual deposition of skins like tectonic plates across their active bodies.
TEN Life:*Chain

I was born and raised in a magic time, in a magic town, among magicians. Oh, most everybody else didn’t realize we lived in that web of magic, connected by silver filaments of chance and circumstance. But I knew it all along. When I was twelve years old, the world was my magic lantern, and by its green spirit glow I saw the past, the present and into the future. You probably did too; you just don’t recall it. See, this is my opinion: we all start out knowing magic. We are born with whirlwinds, forest fires, and comets inside us. We are born able to sing to birds and read the clouds and see our destiny in grains of sand. But then we get the magic educated right out of our souls. We get it churched out, spanked out, washed out, and combed out … Because the people doing the telling were afraid of our wildness and youth, and because the magic we knew made them ashamed and sad of what they’d allowed to wither in themselves. (McCammon 1992, 2)

Bütschli angels frequently form pulsing chain-like formations that stabilise their collective movements. Those that are weight-ed down by their residues are rapidly encased in osmotic films. Strung like dew upon a spider silk filament, they pulse and glitter intermittently until they reach thermodynamic equilibrium.
I opened my eyes — and all the sea was ice-nine. The moist green earth was a blue-white pearl. The sky darkened. Borasi, the sun, became a sickly yellow ball, tiny and cruel. The sky was filled with worms. The worms were tornadoes. (Vonnegut 2008, 187)

While Bütschli angels spontaneously arise from the fuzzy realms of energised chemical fields, they cannot replicate, as their progenitor systems are too primitive to form reproductive structures. Bütschli angels persevere so as long as their generative systems abide and have no need for progeny, for when they fall, others relentlessly take their place. The Petri dish base is littered with angel snow.
TWELVE Life:*Persistence

Movement’s folding in on itself is not something the body does. It is what bodying is. Movement embodies only itself. Movement’s making is corporeogenic: becoming-body. 
(Forsythe 2014, 39)

The complexity of Bütschli angels is time limited and takes on different manifestations across various media. Only when angels replenish their interior metabolism (by feeding) and tend to their environmental health (waste removal) will they discover the path towards (relative) persistence.
Tiny differences in input could quickly become overwhelming differences in output — a phenomenon given the name ‘sensitive dependence on initial conditions.’ In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect — the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York. (Gleick 1997, 8)

Soft as a mosquito’s dance, soap flakes gather on the surface of Bütschli angels, but may be chaotically amplified to become a snowstorm of residues. Unlike cellular life, droplet metabolisms are turned inside out, so their critical exchanges take place at the interface, with no recourse to interiority, subjectivity, or privacy. The inner workings of Bütschli angels are therefore transparent, vulnerable to, and penetrated by the chaos of the world.
FOURTEEN Life:*Fusion

The Theatre of Cruelty has been created in order to restore … a passionate and convulsive conception of life, and it is in this sense of violent rigour and extreme condensation of scenic elements that the cruelty on which it is based must be understood. This cruelty, which will be bloody when necessary but not systematically so, can thus be identified with a kind of severe moral purity which is not afraid to pay life the price it must be paid. (Artaud 2010, 122)

Touching without fusing, Bütschli angels persist until they are exhausted and lie gently metabolising alongside each other. Some livelier angels set traps at the tips of crystalline stalks like predatory insects, waiting for the approach of an unsuspecting warm metabolism. Then, ‘snap’, two become one. A chance finding under fluoroscopy reveals a momentary union of two untethered bodies. The apex of a probing droplet blasts fluorescent liquid, like the spray of a bombardier beetle, into the other. Its discharge twists like smoke until it evenly diffuses throughout the recipient droplet. This fusion was only partial and an extraordinary sight that occurs without record and is now just a memory.
Life: Populations

Their first terraforming move was to sprinkle the precious dirt from their homeland into the planet’s atmosphere, which carried living seeds from their laboratory experiments. After decades, these creeping chemistries went ‘native’ with interesting results. Now slithering scoundrels flop, gaping out of the silt and flap tirelessly on the beach in an evolutionary race to gain a colonising foothold on the hallowed dry land. While the sentinels, who have only just evolved their magnificent tri-legs, raise their skinny bodies out of the puddles, scream ‘no room!’ and pick off the scoundrels in droves as they flail helplessly, in the effort to dry-dirt upgrade. (Armstrong 2018a, 106)

Like weather fronts, Bütschli angels can bring about radical change through events that take place at their interfaces, where highly complex molecular landscapes reach thresholds of transformation, or tipping points, where completely new kinds of molecular patterning, or ordering emerge.

While the source of this creativity is not fully understood, it arises from pre-existing metabolic activity where attractants/stimulants and inhibitors/repellents respond to each other and produce hyperdynamic, transformative landscapes, which generate coordinated group behaviours such as scattering — the inverse of ‘quorum’ sensing in bacteria, which recruits other bodies to the signal site (Nealson, Platt and Hastings 1970).
09.2.5

Death: Quiescence

While we live, we ourselves are inhabited … our bodies are the kitchens were our food is cooked, digested, and then burned to cook us. We live until death in a perpetual fever, 98.6 degrees Fahrenheit. When at last we are well done, we begin to cool, becoming food ourselves. (Logan 2008, 55)

Having danced in the theatre of liquid life, Bütschli angels lie spent among wreaths of crystalline materials, having almost consumed their own bodies in the process. Osmotic membranes snap around their active surfaces like a trap, completing the chemical act of ‘death’.
Death: Regeneration

I had realized the injustice of society, I wanted first of all to cleanse myself, then go beyond its brutal ineptitude. My stomach was the seat of that society, but also the place in which I was united with all the elements of the earth. It was the mirror of the earth, the reflection of which is just as real as the person reflected. That mirror — my stomach — had to be rid of the thick layers of filth (the accepted formulas) in order properly, clearly, and faithfully to reflect the earth; and when I say ‘the earth,’ I mean of course all the earths, stars, suns in the sky and on the earth, as well as all the stars, suns, and earths of microbes’ solar system. (Carrington 1989, 164)

Bütschli droplets may be briefly regenerated when their thick, incarcerating osmotic skins are temporarily broken apart by vigorous agitation. A flicker of life passes through their bodies until the fractures are healed by metabolism, returning the angel to an inert state.

As in the case of living systems, a specific Bütschli angel cannot be restored to its original form once dissipation is quenched from its being. For the angel, this removal from the theatre of liquid life is permanent but living things may be returned into the web of life by slingshotting their decomposed matter back into existing metabolic pathways, where it is assimilated into other bodies. The strange reanimated apparatuses that can perform this function, are the soils.
Bütschli Droplets as Computational Agents

The theory does not make any new hypotheses; it merely suggests that certain well-known physical laws are sufficient to account for many of the facts ... This model will be a simplification and an idealization, and consequently a falsification. It is to be hoped that the features retained for discussion are those of greatest importance in the present state of knowledge. (Turing 1952, 37)

Bütschli angels provide a theoretical and applied experimental platform that demonstrates the technological potential of liquid substrates at far-from-equilibrium states, behaving in unusual ways that are difficult to describe through conventional scientific narratives alone. By drawing on design-led agendas (culture, aesthetics, history, language, poetry etc.) alternative explorations are possible that raise different kinds of questions about the nature of ‘life’, and open up new spaces for investigation.

Even the non-classical behaviours of dynamic droplets defy logical explanation, but fortuitously generate a range of easily visualised outcomes that are also capable of performing useful ‘work’ and therefore may be readily operationalised as a technological platform, capable of interrogating the principles of liquid life.

While not detailed in this book (Armstrong 2015), ‘loose’ control systems can be strategically applied to influence the Bütschli system’s emergent phenomena, which include: adding various salt solutions to the droplets to produce bodies with dense carbonate surface precipitates, or stimulating and inhibiting movement by adding organic solvents like acetone (Armstrong 2015). Thus, the Bütschli system fulfils the equivalent function of the bête machine for liquid life, as it not only embodies a set of ideas but also practically demonstrates them.
Ontological and (Post)epistemological Issues

Listen to the forecasts, note what they say and then use your own knowledge to refine the details for your own area. (Watts 2014, 12)

Responsive bodies in constant flux exceed the capabilities of classical objects, and therefore require a set of terms, metaphorical contexts, and recognisable narratives capable of interrogating our encounters with them. Clues to the kinds of frameworks and metaphors that may be appropriate for this purpose already exist in our concepts of weather (material, systems, lore), oceans (material, systems, lore) and angels (mythology). This is where the language of liquid life begins.
Beyond Classical Categories

The Bütschli system poses a particular challenge to the structuring of knowledge, as it may yet prove to be ‘post-epistemological’, or uncategorisable in any conventional way (Latour 2013). The implications are for establishing meaningful encounters with its inevitable paradoxes such as — measuring the unmeasurable, valuing the unvaluable and recognising the unknown. Droplets exhibit unique features that are characteristic of non-linear systems, which are not fully resolvable using classical approaches. Their complexity, organisational diversity, extreme environmental responsiveness and intersections with other ontologically distinct systems such as machines, implies their outputs are not only constantly moving physical targets, but also conceptual ones. Consider, for example, Venice in the following terms:

Life is in a state of oscillation, as heartbeats quell and dead things explode from composts into animated states. Creatures like ichthyosaurs, trilobites, coelacanths, megalodons and ammonites, awaken from fossil beds, to live again. Beings that have been erased from the world’s imagination are already forming in wombs, where it is impossible to count the number of limbs and eyes as they perpetually roll in knots of dough-like flesh and blissful embryogenesis. Bodies wander through adaptive fields, digestive juices, and egg sacs, which constantly remodel their bones then explode into dust. Tinged with blue copper-laden blood, the lagoon seems built from thick folds of meniscal flesh, full of heavy metals and other kinds of uncleanliness. It’s a place where creatures simultaneously freeze and boil, holding up a mirror to our darkest urges and most grievous ecological atrocities. This realm imagines us extinct. (Armstrong 2019, 97)
It is challenging to view and describe the constantly changing Bütschli system without assimilating it into pre-existing knowledge sets, like the *bête machine*. However, this is exactly what needs to be done if the full potential of this emerging technology is to be fully explored and imagined. Bodies in constant flux are not unknown to us. Their concepts and metaphors reside in the expressions of our encounters with mutable matter like oil slicks, reflections, murmurations, flames, developing embryos, snot, waterfalls, shoals, the weather, and oceans. However, our strong preference for bounded objects that can be ‘names’ and ultimately controlled, has left the mutable, intangible, inconstant, and transitional aspects of being incompletely characterised and interrogated. Re-engaging the protean aspects of reality may conjure forth qualitatively different kind of encounters with the living realm, which provoke alternative forms of knowledge.
Notating Life

I was struck by the idea of drawing a diagram of my life, and I knew at the same moment exactly how it was to be done … I should … speak of a labyrinth … with … many entrances leading to the interior. These entrances I call primal acquaintances; each of them is a graphic symbol of my acquaintance with a person whom I met, not through other people, but through neighbourhood, family relationships, school comradeship, mistaken identity, companionship on travels, or other such hardly numerous situations. So many primal relationships, so many entrances to the maze. But since most of them — at least those that remain in our memory — for their part open up new acquaintances, relations to new people, after some time they branch off these corridors (the male may be drawn to the right, female to the left). Whatever cross connections are finally established between these systems also depends on the intertwinements of our path through life. (Benjamin 1999, 614–15)

Dynamic droplets perform on an ‘ever-changing stage’ (Tschumi 2012, 28) that takes the form of an olive oil field. To provide a notational map of the Bütschli system, an oceanic ontology was derived from discrete events that took place during a series of over 300 experiments. All of these were conducted at room temperature using 3 M sodium hydroxide drops, which were added by hand to the olive oil field (Armstrong 2015).

At the centre of the map, concentric circles, which are logarithmically spaced to indicate passing time in the system, radiate outwards from an initiating event at the origin. Following activation, an estimated 90% of chemical activity is completed within five minutes. While individual droplets may be active for as long as an hour after their genesis, the greatest diversity of events is observed during this period. A spiral also emanates
from the origin, which depicts increasing complexity in the events clustered around the start of the reaction, which become less frequent as time unfolds. The various outputs are grouped according to recognisable events or structures, like the ‘were-wolf’ moment (see section 09.2.3.1.4.2).

Produced by the interactions between actors, the resultant map does not propose a formal classification system, but acts as an avatar of events that are shaped by informal and subjective accounts of the system’s possibilities. Since these are open to reinterpretation, the Bütschli system’s oceanic ontology may be regarded as a framework for storytelling.
Conclusion: Bütschli Droplets and Liquid Life

And with the hieroglyph of a breath, I wish to recover an idea of sacred theater. Antonin Artaud, *Le Théâtre de Séraphin* (Damisch 2002, 200)

Bütschli droplets provide a lifelike model that facilitates discovery of the non-biological, ‘living’ realm. They reveal surprising encounters that raise questions about the nature of life and the character of lived experiences. Enabling the visualisation and iterative testing of liquid life’s concepts, so they can be refined (Armstrong 2015), dynamic droplets draw together the conditions for continual change and provide a cauldron of toolsets that provide insights into the ‘adjacent possible’ (Kauffman 2008, 64) of the living realm, which is beyond our current capacity to calculate. Constituting a visualisation system and technological platform, it becomes possible to observe how living systems ‘could be’ if they were composed from alternative modes of organisation than constitutes the biological realm.

The Bütschli system demonstrates that liquid life is ebullient and extends beyond its apparent boundaries to excoriate its niches and neighbours with tangible effects. This being-in-the-world (Wheeler 2011) is characterised by non-linear systems like dissipative structures, which combine fluidity with the transformational repertoire of matter, to mount mischievous material resistance against entropic forces.

Like a waterfall whose journey to the ground has, so far, been prevented by the collisions it has encountered on the way, liquid life finds a way to slingshot around the rock face through the metabolisms (digestion, anabolism, assimilation) of other living bodies and agents of strategic decay like the thanatobiome and necrobiome (catabolism, composting), so that it may fall again in other ways. This metabolic waterfall ‘elevator’ is a metaphor for the processes that underpin the 3.5-billion-year unbroken legacy of modern biology. It highlights an oft-neglected
truth — that life is only possible when it is deeply entangled with the rich metabolisms of death.