The Lucy Cranwell Lecture
The Natural Community: Forest and Shore
5 October 1994

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These lectures are instituted to pay honor to Lucy Cranwell. It is a privilege for me to be allowed to offer a tribute of my own this year. Being a prime-centred zoologist should not exclude me, for in temperament and gifts, and by the necessity of her time, Lucy herself had a renaissance vision. In a day when the University had scarcely thought to make natural history available to ordinary people, or those of us still in school, Lucy had - with the rest of the small handful of Museum staff - succeeded in this ahead of her time. This is a mission the Museum could be renewing today with a changed academic and economic climate.

Lucy Cranwell it was that brought botanical study out of the dry herbaria into bush, wetlands, dunes and on to the shore. When I met her first at about 14 she bade me to leave aside "all that dull dissecting" until University days, and move out into the field. I don't recall if I told her that I had through childhood been doing that at Milford Reef, and with fascinated and faithful intensity - though I had never in my isolation got to Piha or pushed further north than Waiwera.

These were historic years when the "two Lucies", (Cranwell & Moore, 1938) were making their own first incursion into marine intertidal ecology at the Poor Knights. W.R.B. Oliver's fine 1923 paper notwithstanding, this was to be the first real insight into the zoning of our marine shores. It was a highly original "first", partnered with Lucy Moore then doing a poorly paid apprenticeship as "Barney" McGregor's sole-charge zoology demonstrator.

It was Lucy Cranwell who at the Museum showed me my first object through a research microscope, a rimu pollen grain, that I remember well enough - with all its pimples - to draw it today. She had also taken me up to the Museum library and got me out T. A and Anne Stephensons' first papers - just arriving fresh and new - on the zonation of South African shores. They confirmed my dawning perception that it was possible to take a whole shore as an object for study, with its patterns and symmetries, and even - as I was to find - its ontogeny and long-term cycles.

Lucy Cranwell could communicate freshly and well. Here is her introduction to the Poor Knights paper of 1938. *"One of the most striking features of certain of the offshore islands of the North Auckland coast is the many-ranked and beautifully symmetrical zonation of intertidal communities. Bands of sessile shellfish and seaweeds run like white, red and brown ribbons around the shore, a striking local expression of the incidence of certain major factors operating throughout the whole littoral region."*

I want to begin this lecture with the two Lucies' simple and so accurate perception of those *white, red* and *brown* ribbons, and the global universality of which they are a such beautiful and widespread component.

The shore community has for a century and more been one of the earliest engrossments of marine and other ecologists - long before *ecology* itself had become first a technical term - or today a constantly canvassed political word.

Need I apologise, any more than the Lucies, for speaking to botanists about animals? T.A. Stephenson - as we read - once severely reproved a young botanist who had had the opportunity of examining shores never before described ecologically. Not only had he ignored the animals, but even then he had shown no appreciation of the seriousness of the omission, failing to realise that the key to the distribution of his algae lay primarily with the animal!

Equally severe was the old master in holding excessive ecological terminology to be an 'unmitigated pest', holding with Sir Charles Singer that "ecology from the beginning has been cursed more than most sciences by a horde of technical terms equally hideous, un-necessary and obfuscating." Under salutary warning, I shall here use only the nearly vernacular word *community*.

With the like simplicity I shall point to that prime attribute of almost every rocky intertidal shore, that we would first train our students to look for and recognise. It is the existence in the down-shore succession of three thresholds: the *barnacle line*, *pink line*, and *brown algal line*. First in New Zealand, these were to be realised at the Poor Knights.

Two very opposite concepts of the *community* have been promoted at different times of its history or by different schools of ecology. An idea much advocated - when I was an undergraduate - by an American following of Park and Allee was to view the community as a *super-organism*. As such it was an assemblage endowed with an almost mystical integrity, like a cell or even an individual organism, having parts, metabolism, growth, ontogeny, senescence, and finally death. Little real evidence exists for all this in their published arguments; and little - as I believe - in the facts of nature. For all its observed integrity and stability, the internal relations of a community are not those of a genetic harmony or invariant constancy. Instead there are elements of tension and conflict, however stable may seem the dynamic stalemate these often achieve.

Meanwhile more and more sceptics, largely from statistical analysis, were raising the question *Do communities exist at all?* Most would agree that discrete boundaries cannot be drawn except where abrupt physical discontinuities exist in the continuum of the environment. Plankton communities or those of sediment sample cores, obtained from blind-dips into the medium, give us no inkling of boundaries in space. Their "community" status is based simply on a statistical evidence of co-occurrence.

Among plant ecologists, an influential figure still quoted in my student days, was the American E. D. Gleason with his doctrine of *species individuality*. First, he maintained - *no two species are alike in distribution* - each is distributed according to its own way, structurally and physiologically, of relating to its environment. Second, species with ranges measured along ecological gradients would be found to *intergrade continuously* rather than forming distinct clearly separated zones. Moreover, species along an ecocline should have sharper, more separated divisions as they diverge selectively. Each of the species making similar demands on resources will tend by competition and natural selection to be kept apart, to *evolve separate habitats*.

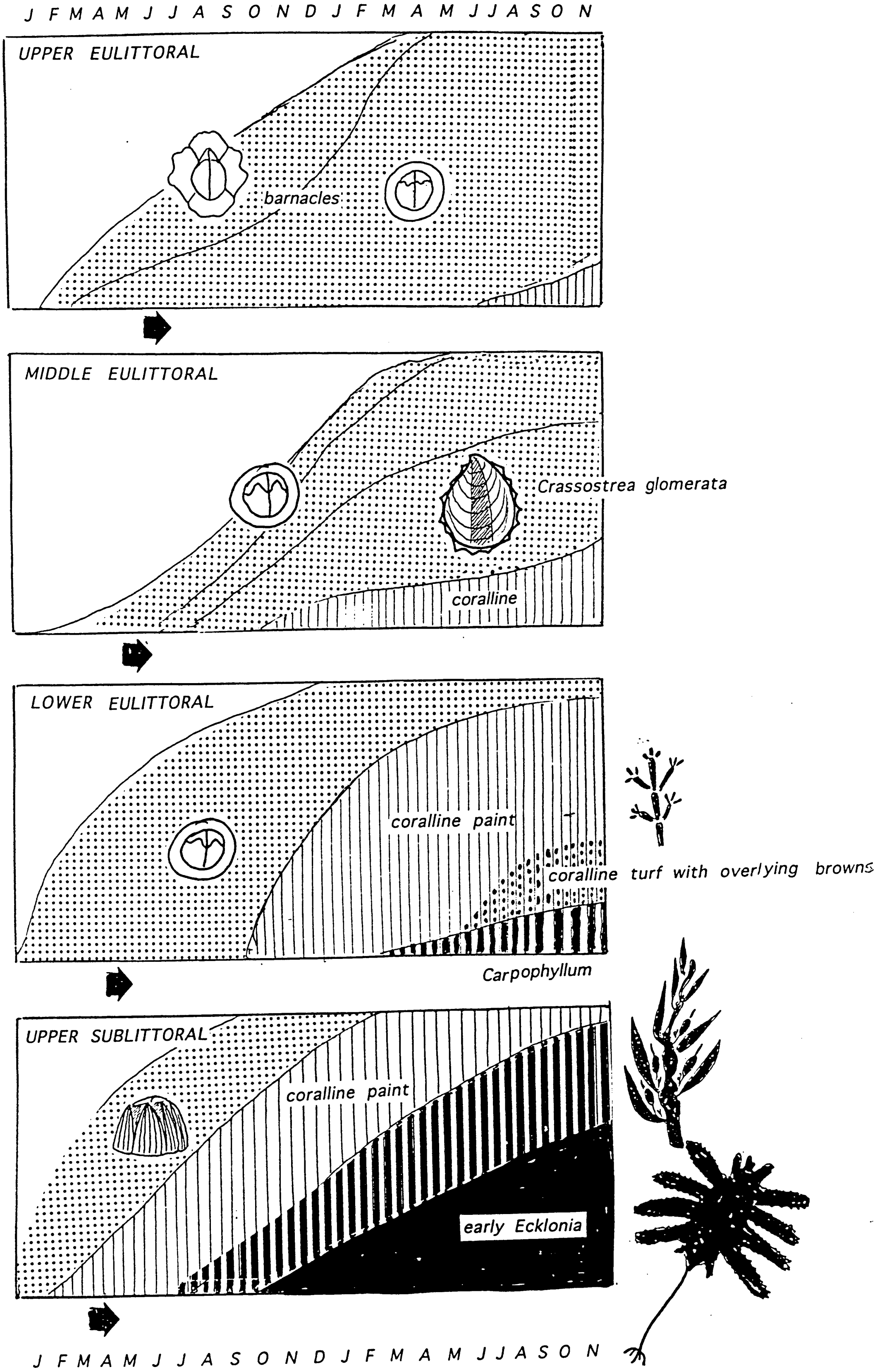
Is this not demonstrably so, it could be asked, in respect of barnacle, corallina, *Carpophyllum* and *Ecklonia* upon the shore? Have we got with the shore community, not *alpha diversity* - with a high number of non-dominants in one area, but *beta diversity* as seen by spatial succession, with single-species replacement along a cline of change. Fucoid algae on British or East Canadian eulittoral could illustrate this. A species will not occupy the whole of its potential and possible range. Competition will secure that it lives *not where it can but where it may.* New species may thus get interpolated by the contraction of the ranges of competitively inferior neighbors.

Does this dictum hold good then, that selection leads primarily *away from* and not *towards* the formation of communities? Gleason's disability - I believe - is one to which some plant ecologists have been disturbingly prone. It is to confine *community* to the large photosynthetic macrophytes that form the canopy part of the first (photosynthetic) trophic level of terrestrial forest communities.

The intertidal biologist would mean more than this by community. He would most of all contest the assertion that other plants and animals do not form zones broadly comparable with those of the dominants. That statement could meet the same challenge by any botanist working in rain forest as against single dominant, low-diversity, deciduous or taiga forest.

The truth of other species broadly coincident in range with the dominants is attested in the biotic interdependence of *high fidelity species groups.* With prey-specific predation, camouflage or other substrate dependency, including mutualism, such groups increasingly abound in the tropics. Above all we need to be clear what we understand by *diversity* in its ultimate extent. How far can our understanding of diversity be satisfied by co-existence at a single time?

Figure I. The temporal succession at four shore levels at Campbell's Bay.



Spatial Diversity - as we have recognised - can exist in two modes: as in *ALPHA* and *BETA*. The second is shown in the one multiformed community in the various expressions of its potential. We thus cannot adequately represent the community by encapsuling it in *SPACE* at one section of *TIME*. Its other dimension of diversity is *temporal*.

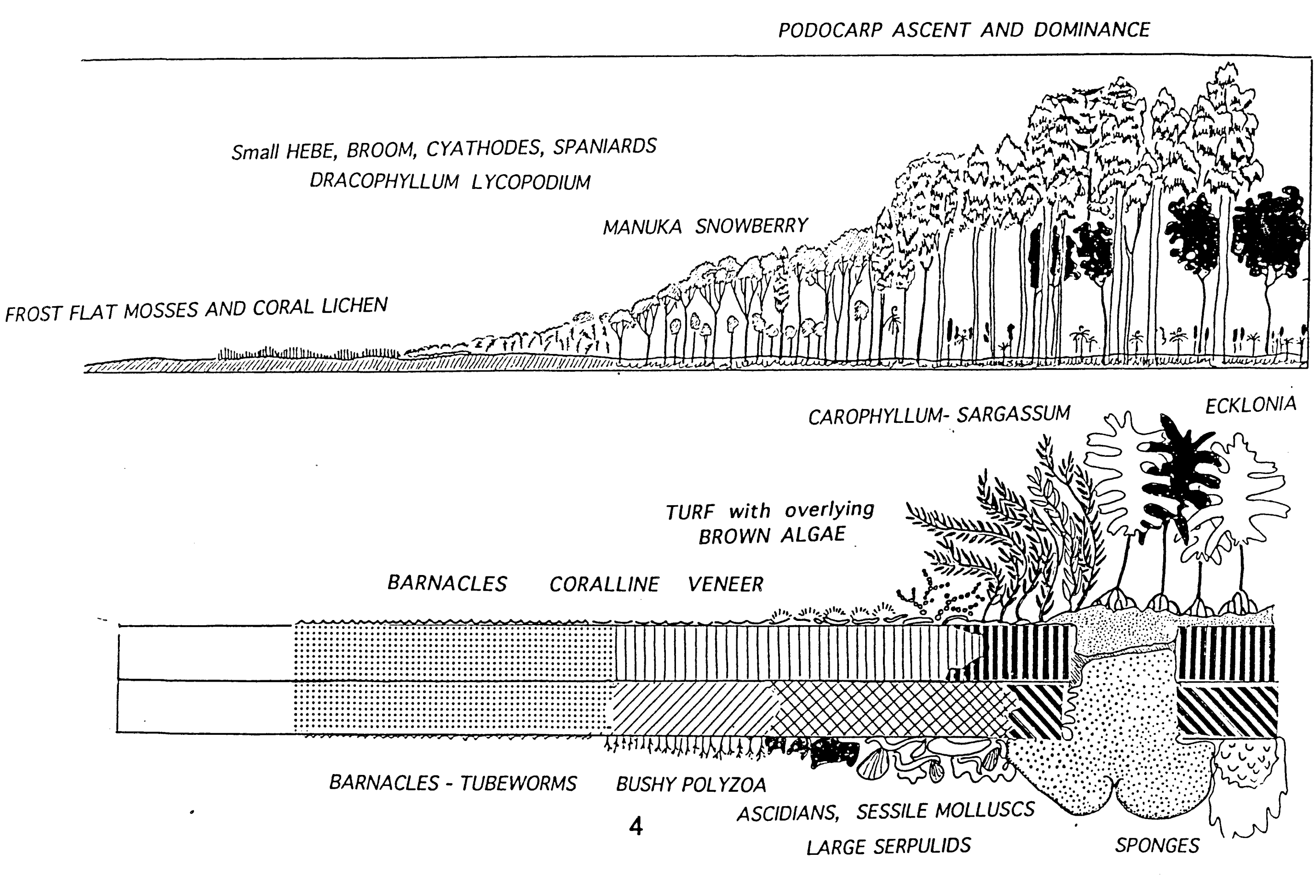
Communities are hence *diversified over space*. First - and most obvious - we may take the zoned strip of a community from top to bottom of a shore. After the warm, bare rock, carrying its *periwinkles* - with *lichens* still higher up - come the three strips that are regularly twice a day submerged and emersed. Already exemplified on the Poor Knights, these comprise first *barnacles*, then pink *coralline*, then *brown algae*. They are set off by the three well-marked lines or thresholds visible on almost every shore. In the middle band, temporal diversity can be rhythmic and seasonally repeated - see for example, Betty Batham's picture of the rise and fall of spring and early summer brown algae *(Scytosiphon, Scytothamnus, Adenocystis, Leathesia).*

But there is also change over time that is *progressive*. Barnacle, coralline and brown alga may be related not only successionally in *SPACE*. Using a different label on the arrow, they can follow successionally in *TIME*. Such a temporal succession - white to pink to brown - was observed at Milford, Auckland, from basalt experimental settling slabs, laid out at different shore levels during 30 months. Figure 1 brings out too the acceleration of the succession rate in proceeding down-shore towards low tide.

We have here found out from our experimental settling slabs something important about the shore community - what it fully is, how it needs time to express and how a process of *succession* operates.

We find here a key to community structure, showing it as not single-form static, but *progressive and dynamic*. Botanists will not need reminding of the long scale historic movement in the ecological succession of a rain forest. I can well recall the course of events at central North Island's Whirinaki, on its western edge, with succession leading through mosses with coral lichen; small *Hebe*, broom, *Cyathodes, Aciphylla; Dracophyllum* with *Lycopodium;* kanuka, and podocarps, up to a final climax - some would predict - in tawa. (Refer to Figure 2.)

Figure 2. Ecological succession of a forest (above) and a shore (below) - lighted surface and under boulder.



Succession at Whirinaki is a scenario of centuries. There can be much shorter successions. A protozoan culture, with bacteria followed by flagellate monads, and then to the ciliates *Paramaecium* and *Stentor* could run through its succession in a week or two. Of about the same order of time is the succession of saprophytic organisms - bacteria and fungi - involved in making and ripening a cheese. A camembert in its small box comprises both the *biotope* (site and environment materials) and the *biocoenosis* (set of organisms). The succession of saprobe species, with the earlier *facilitating* or preparing the way for the later - runs from *Lactobacillus* through to *Aspergillum camemberti.*

None of this is a *productive* sequence, based on photosynthesis with chlorophyll. Its basis is *reduction* with release of nutrients in the dark, ultimately to be available for a new lighted cycle. Such a reductive regime is to be studied beautifully in a garden compost heap. But the camembert or stilton has the palm in point of elegance!

A mercifully short succession is observable (albeit without pleasure) close to home, beginning in my own naso-pharynx with the choriza virus of the common cold. This runs quickly enough through its sequential stages with staphylococci - and hopefully nothing further - moving in mildly to congest the bronchi. My own defensive force of my immune system blood cells forms in itself a last - and victorious climax stage of the succession.

The intertidal shore has many virtues for experimental ecological study, not least successional studies. The available living space is strictly partitioned - with animals and plants miniaturised, fast-settling, fast-growing and reproducing. One of its beauties is that the temporal course of the succession has been nicely accommodated to the short or middle time span, say three years, well adapted to the requirements of a thesis at PH.D.

Succession

Let us tabulate the changes characteristic of a succession, based originally on one of the major vegetational communities on land. Almost without the change of a word, we shall find them cross-comparable point by point with the intertidal succession we have been looking at on the shore. I have borrowed the stages from the text book of R.H. Whittaker.

First, the substrate becomes extensively altered and developed from its early state on bare soil or rock.

Second, the biotic strata develop increased height, massiveness and differentiation.

Third, productivity - or rate of formation of organic matter- increases with development of community structure.

Fourth, as height and complexity increase, microclimates are increasingly determined by the characteristics of the community itself.

Fifth, species diversity increases from the earlier to the later stages, sometimes declining before climax.

Sixth, populations rise and fall to replace one another along a gradient just as do stable communities along an ecological gradient. The rate of such replacement may slow down as smaller and short-lived species are replaced by larger and longer-lived species.

Seventh, not only diversity but stability increases as the succession advances. The earlier stages are evidently very unstable, with populations rapidly replacing one another. The final community is usually stable, dominated by long-lived species which maintain their competition, showing oscillations but no longer directional change.

Climax

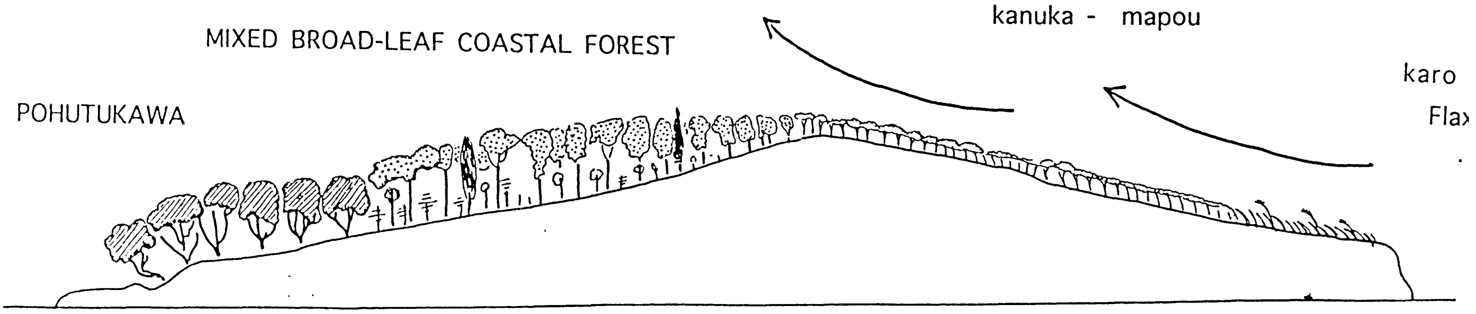
The *climax* then, as the final stage of a succession, is held to be marked by various sorts of *stability* - in the balance of assimilation and growth; of biomass and productivity; and of the generation of diversity. At climax all these are held to be in steady equilibrium. With little doubt, stability is a property of high community organisation, that is found to increase through time.

In many land habitats, the determination of the climax is recognised to be complex. One vegetational area may contain a number of different kinds of community climax, corresponding with the mosaic of different habitat conditions. Thus there may in some areas be patches held back to *pre-climax* successional communities. We thus have on land a *poly-climax* mosaic, varying according to aspectation, rock and soil type, wind effects, drainage and other environmental parameters. Generally it is the most prevalent sort of climax condition that has been called the "*climatic climax*" - being the one with the most extensive or representative cover in a region or geographical area.

Aspectation is a familiar commonplace of vegetational distribution. Where there is a sunny north-facing slope, we may see tall, old-age kanuka. A southerly slope with shade will show patches or a continuous canopy of silver fern (*Cyathea dealbata).*

Good examples of aspectation may be produced by on-shore salt-laden winds. Small Goat Island, just outside Cape Rodney, shows this graphically with its two faces, essentially a *leeward* slope turned to land, and a *windward* slope out to the full Pacific. The south-facing leeward slope over the channel towards the Leigh Marine Laboratory has fine pohutukawa and towards the summit a coastal broad-leafed forest of mahoe, *Pseudopanax lessonii*, and rewarewa, with a good shrub understorey of kawakawa and *Coprosma rhamnoides.* Seaward is a low wind-sheared canopy, tough and resistant, composed of manuka and mapou, with a seaward edge, above the cliff lichens and halophytes, of flax and karo. (Refer to Figure 3.)

Figure 3. Aspectation at Goat Island.



GOAT ISLAND VEGETATION

Quite clearly we are dealing here with the arrest of a succession - in a particular climatic condition - at a *pre-climax* stage. With the intertidal zone, the situation is more various and intense. Above all it can be seen that the succession is miniaturised in space and in time, just as its constituent species are miniaturised in size. Examples of aspectation are widely to be seen. At low tide, on the landward part of a stable boulder turned away from wave-splash there may be bottle-green *Codium*, and to seaward a wafer-pink *Corallina* veneer. In the mid-eulittoral, looking down-shore, the shaded back-sides of boulders may be reddish brown as if with dry congealed blood, all crusted with *Apophloea sinclairii.*

But the predominant theme marking out the intertidal shore - as we recall - was the Cranwell and Moore succession of *white, pink* and *brown* bands or ribbons. These can owe nothing - like the divisions on land - to soil or edaphic or local shade factors. The climatic factor that is graded along the steep shore ecocline is the ratio of *submersion/emersion*, with its differences in *insolation* (penetration of sun's heat), *desiccation*, and amount and spectral quality of *illumination.* The sequence or succession through *time* that we saw from our settling plate experiments is now - in the visible zonation pattern - transformed into and perpetuated as one in *space.*

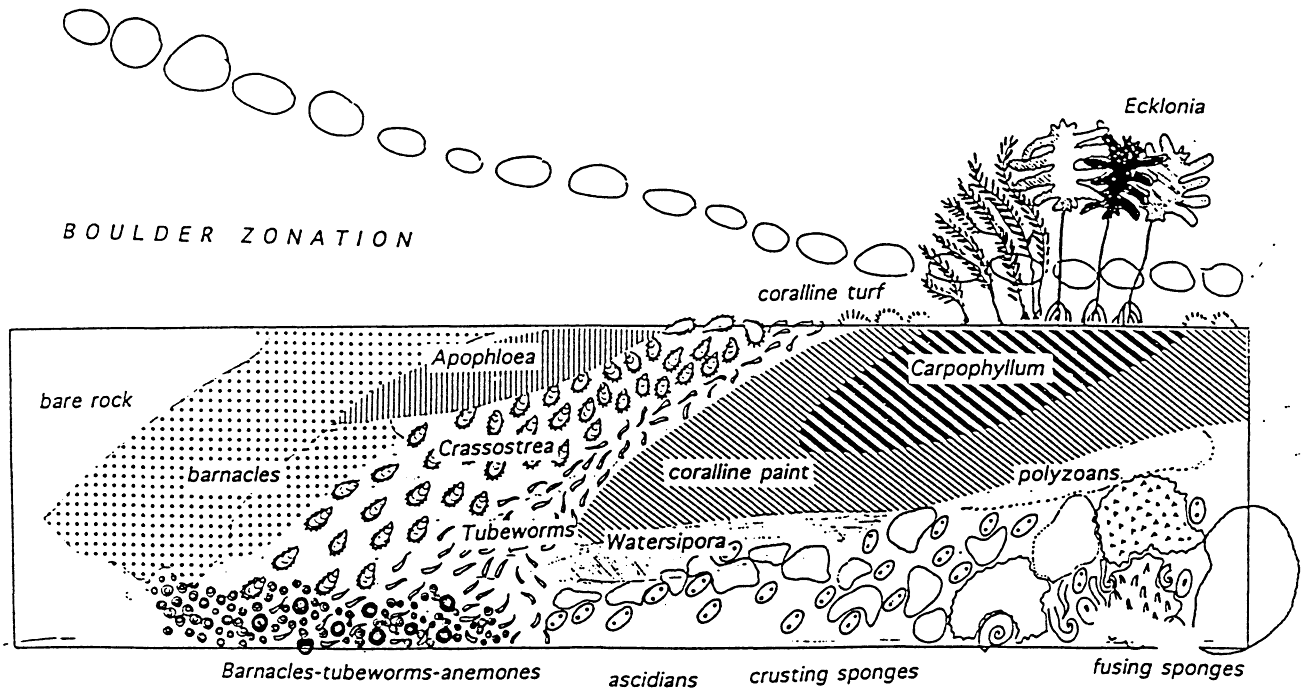
Not only will the spatial mosaic of the shore vary in its dominant form over narrow areas. The sustained dominance by different species - or multiple sub-climaxes - in their series down-shore is the very basis of the intertidal zonation pattern. There is a *polyclimax in space* drawn from the pattern of temporal succession revealed in essentially the *one community.*

So we can find illustrated on the intertidal shore, and miniaturised in space, one of the great truisms of ecological distribution. In difficult, stressful habitats - and one of these is sun-warmed bare rock - it is *climate* that imposes the constraints. Successful species are few and highly adapted. They may often be ancient members of a group, small in size like barnacles, or elemental in structure like lichens or blue-green algae, and securely protected against high temperature, light and water loss. In the most rigorous of habitats, high on rocky shore or on harsh mountain slopes just below the summer snow-line, dominance will be high, with a few rigorously adapted species.

The top of the shore we have very little diversity, though a mountain slope - just beneath the austerity zone of lichen and moss - can in summer present us with a brief diversity, in our small but important community of alpine flowers. We can first behold it for ourselves, with the joy that William Colenso knew, on crossing the Ruahines in 1834, to find the hard shingle ablaze with daisies, gentians, buttercups, blue-bells, eyebrights and speedwells.

Going down-shore (just as we might have continued down the mountain-side) there is progressive evidence of fuller diversity, with less single-species dominance, and with climatic constraints relaxing. Instead there is increasing *biotic competition* with other plants and animals and an increasing measure of *opportunism* in settlement. Ultimately, there is the chance result of a casino or a market economy, according to a species' success in the lottery for available space.

Figure 4. Community above and below intertidal boulders, from high to low water, Whangarei Heads.



Here then we have found a progression, running through essentially the same scale of diversity, that can happen down a mountain slope of 8,000 feet, down a tidal shore of 8 feet. But the great naturalist-traveller von Humboldt was to find its equivalence not just from sea level to a mountain top, but through the 8000 miles of a whole hemisphere, from Arctic tundra to equatorial rain forest. A *Mountain*, a *Shore line* and a *hemisphere*, show us the same gradation, from austerity to luxury. And now I want to show you this principle, still being exemplified from the top to the underside of a single inter-tidal *boulder.*

Boulder Communities

On a shore-boulder there is community gradation of just this same order of significance. Underneath the boulder - sequestered from light - a shade community - we call it *dark-loving or sciaphilic* - develops wherever there are dark places of uniform temperature. This cannot be called a full *community*, if we insist on reserving that term for an autonomous, self-contained ecosystem. Within its spatial confines of a sciaphilic community, there is no photosynthetic *production.* Its chief life-forms are sessile animals, fixed down and reliant upon phytoplankton brought in by currents from the wide oceanic system outside. Their "big groups" of leading forms are barnacles, tubeworms, bryzoans, simple and compound ascidians, crusting sponges and fusing sponges. The leading mobile organisms - almost biologically custom-built - are the different *CRAB* species - adaptively. engineered, it could be said, for each boulder situation.

We also placed settlement plates at low tide on the vertical piles and horizontal stringers of *wharves.* Here we can observe a habitat-space with shade enough to carry a sciaphilic community. It contains also *Ecklonia* kelp, an alga with a comparatively low light requirement that can reach from its attaching hold-fast to bring its fronds into sufficient illumination.

Scenario

For the sciaphilic community under boulders we can try to set out the observed *scenario* followed by the succession. If we may designate the bare rock surface as the *First* stage, we shall find *Second,* underneath just as on the surface above, there is a pioneering settlement of the fast-growing barnacle *Elminius modestus*, mingled here with an early burst of tubeworms - first serpulids, later and in faster current *Spirorbis*. *Third, Elminius* may be early replaced by a crustose polyzoan rather than the bushy species of wharf piles. Smaller numbers of compound ascidians soon come in, especially *Didemnum candidum* or *Dipolosoma macdonaldi.* The *Fourth* stage is reached with the entry of simple ascidians *Corella eumyota* and *Asterocarpa caerulea.* The *Fifth* stage, generally reached at third and subsequent years, is dominated by sponges. The earliest sponges are generally the red encrusting forms *Microcosmus, Ophlitaspongia* and yellowish brown *Halichondria* and *Haliclona. Sixth,* the latest to arrive are the bulky species *Ancorina alata, Spongia reticulata* and *Cliona celata.* Ultimately these fuse into tumid masses that attach neighboring boulders firmly together.

The final or *old climax* situation is then represented by slabs or boulders immovably welded, with coralline crusts above and massive sponges below. The originally mobile rock cover has by now been biotically transformed into a cobbled immovable pavement. In biological terms it is firmly "macadamized".

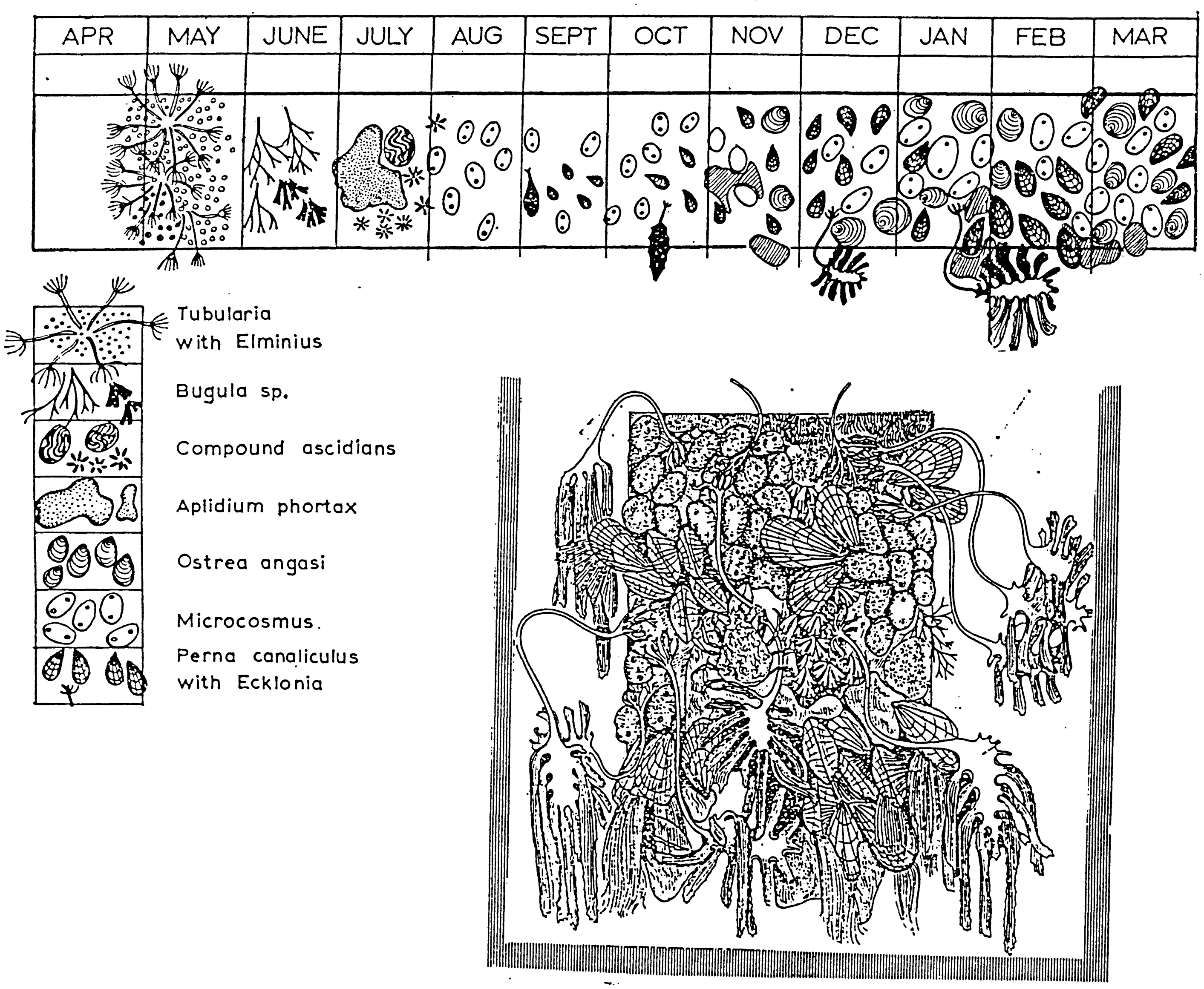
The passage to a climax community under boulders is likewise to be understood as a *multiclimax* situation. Thus, the scenario will proceed its full distance to stage 6 only in conditions that allow prolonged terminal stability. This stage, where we find it, will present a large predominance of sponges, not only the *crusting* ones but increasingly those that *fuse.* Such *finished* communities - as we may call them - will be found at or just beyond low tide - often where *Ecklonia* attaches to the boulder top. They will be old communities, heavily loaded, with no bare rock surface left, stable and for many years undisturbed. Such boulders are found in strong shelter, though not in not in enclaves so enclosed as to become silted up. They will proceed ultimately towards the very old, slow-growing communities of brachiopods and cup-corals, most notably to be seen subtidally.

In striking contrast are the mobile boulders at the *Little Barrier* landing place - with the low noise of grinding as they constantly turn over and abrade each other, finally to become rounded. On such boulders, the scenario will be scarcely initiated, or never become far advanced. Their surfaces will be at the Stage O of bare rock, or carry just a transient scatter of few of the organisms that would normally settle first.

A middle sort of colonised boulders could be typified by those as of *Goat Island Bay* - outer coasts where boulders are slab-like or flat enough to give some continued stability, but are swept underneath by constant laminar currents. These will be not *sponge boulders* but *bryozoan boulders*, with a diversity of thin, low-relief colonies, pallid or colourless. Nearer the margin will be an overstay of tubeworms and compound ascidians; but the sponge stage will hardly be reached.

The stage of the scenario able to be attained by a boulder will be governed then by its *stability*. On Little Barrier Island, with a 24 hours blow, 100 % of marked boulders were found to change position. As a boulder is overturned, succession that has climbed the ladder to whatever distance will be removed, as with a snake, descending always back to base line, as a community perishes in light and high temperature.

Figure 5. Succession pattern through 12 months at Devonport Wharf.



The *stability* of a boulder against overturn will be a function not only of its *shape* but its *size* and the amount of *wave action.* Thus, on the shore in Leigh Harbour (Figure 6) it will be the largest boulders at each level that will display the most mature colonisation. We shall further find that with distance down the shore, longer immersion and feeding time will for boulders of equal size and stability, correspondingly advance the succession.

We can further realise that in passing - by Ballantine's *biological exposure scale* - from *exposed* to *sheltered* shores, maturely zoned boulders will have a different climax mix. Thus we can illustrate the proportions occupied by stages I to 6, on boulders from moderate exposure to shelter.

Already, our glimpse of communities under boulders - in high colours normally destined never to be appreciated by the eye - has brought us to point where we can consider the wider community beyond tides.

The Subtidal

The shore community continues down the steep sub-tidal cliffs beyond low water. Realised and mapped out by growing numbers of *SCUBA* divers, it is not strange or abruptly changed. The notional low water mark would seem almost a biological non-event. The brown algal community strongly continues - at first *Carpophyllum* with its pavement and veneer of pink coralline. These two co-exist, as in the low intertidal, and descend together until the failure of light for photosynthesis cuts out first the brown algae then the calcareous pink.

But the great predominance of the subtidal algae is in the tall kelp forests of *Ecklonia radiata -* up to 3 metres in stipe length and forming a virtually closed canopy. Kelp species are most characteristic of cool temperate coasts. *Ecklonia* may stray sparsely into the intertidal, from their forest formations offshore. They have their own herbivores - in a compact assemblage of grazing gastropods, and from their leaves pieces are bitten out by kelp-fish *Odax pullus.*

But the great control of the high *Ecklonia* profile is by the action of a biological *perturber*, in the sea urchin, kina (*Evechinus chloroticus*). It is kina that are felling the forests to cut them back to meadow - just as forests on land can be cut back to productive grassland. The urchin pasture is also highly productive, with sponges and sessile invertebrates diverse and numerous, over a continuum of pink. All this meadow is grazed and kept short by the *Evechinus*, as large dark highpoints dispersed all over it.

In *Evechinus* then we see a *keystone species*, like the *Stichaster* star at low tide on the west coast that removes mussels, to open up - in the result - space for a new instalment of diversity space. The resultant pattern is rich, complexly switched and controlled by fishes and opisthobranchs that in part selectively predate.

All this zone, with algal canopy supreme, or alternatively deforested to kina meadows, we call the *UPPER SUBLITTORAL.* Its effective depth will vary at different places, according to water clarity and consequent penetration of light.

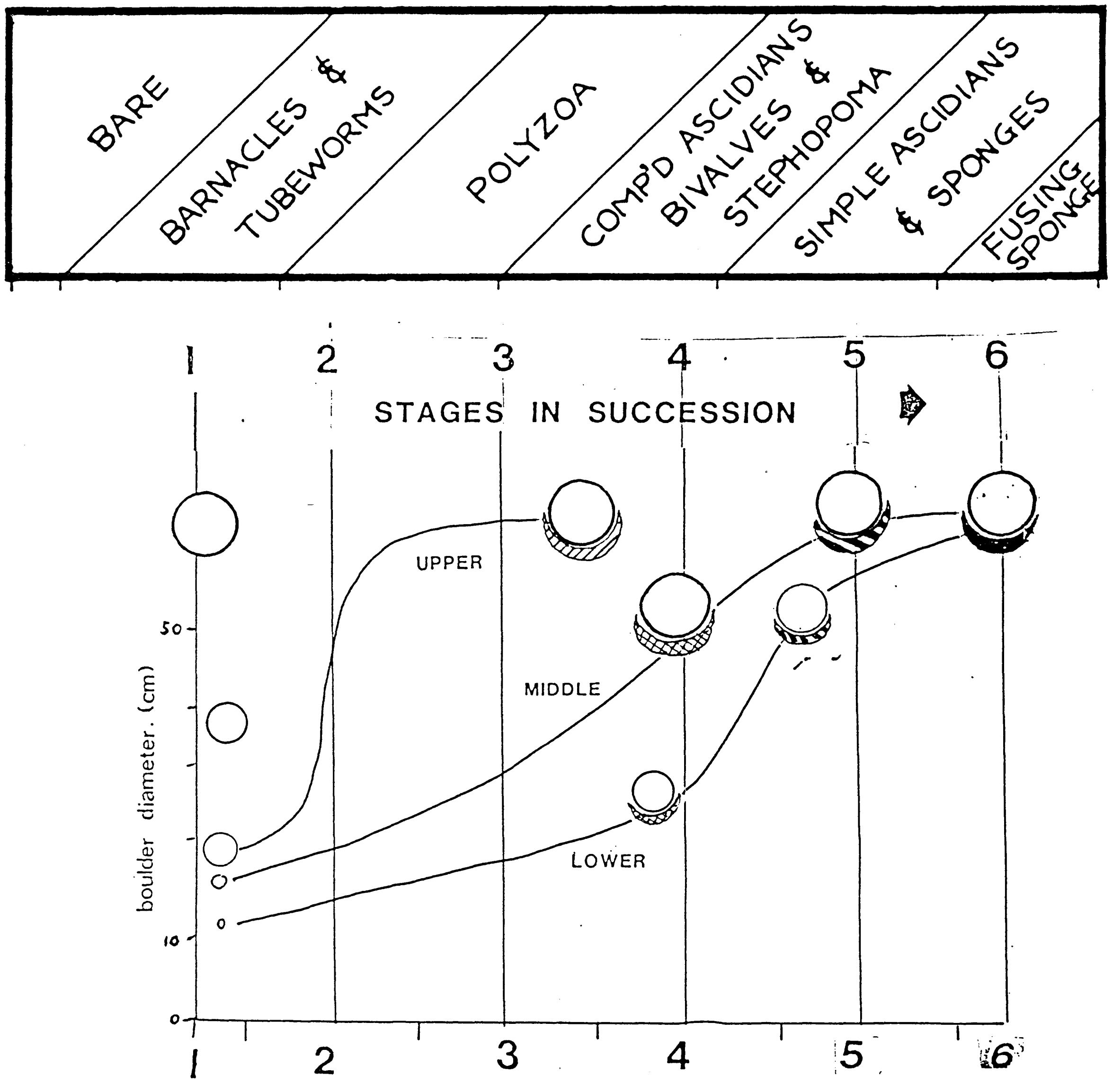
Beyond this comes the *MIDDLE SUBLITTORAL* - a coloured terrain SCUBA divers first encounter with delight and almost unbelievingly - to be lingered over, photographed, dreamed about and returned to. There is almost every colour except algal pink, though we can just at the bottom of the upper sublittoral see the lowest holdfasts of kelp.

The most vivid colours now belong to the predominantly siliceous sponges: scarlet, jet black, turquoise, cinnabar, saffron yellow, brown, tangerine - as well as snow-white. Along with the sponge too are ascidians and bryzoans.

Of all sessile animals, the sponges are the oldest and most archaic. Slow-growing - not yet organised into individuals, their colonies have neither nervous nor muscular nor circulatory systems. Instead, a sponge interior is a histological Venice, a water-works impelling currents through canal systems by special *choanocytes* or collar cells. Sponges have their warning colours serving notice they are smelly and distasteful. They even carry as defences their own antiobiotic chemicals.

Going deeper, illumination gets lower. At very low light levels, much of the terrain is snow-white - with calcareous sponges and tubeworms, especially the myriad serpulids and spirorbids. There are however high colour points of scarlet - cup corals and red brachiopods ancient and ultimately dark-loving. Dark-lurking too are the crayfish or rock lobsters, brick-red and khaki, poised in rows under overhangs or in crevices, drawing back behind forests of alert antennae.

Figure 6. Leigh: Stages in succession attained by different boulder sizes at upper, middle & lower shore levels.



The fishes at this low level, as on the Deep Reef at Goat Island, are browsing carnivores; trigger fish standing on their heads to crop or lunge at food, and red mullet with long exploratory barbels on the chin.

Here then, beyond the cut-off of effective light, is a new *sciaphilic* or dark-loving community - the second of the two great living formations investing the shore. You can see graphically where this change-over occurs, by turning over a clean low-tidal boulder and finding the sharp or indentured cut-out of pink, where the light-supported community ceases, just behind the margin. Far more than traditional low water mark, it is with this final pink edge that we meet the threshold of a new realm.

This same realm we have first glimpsed under low tidal boulders. In these dark sites a rich, colourful and diverse community runs through its own scenario. The "big three" encrusting groups after tubeworms and barnacles are in order of time, *bryozoans, ascidians* and finally *sponges.*

We can artificially contrive a diminished sciaphilic community within the alkathene piping of a seawater circulating system. There - with total darkness but architected to a strong current flow - we shall find a pallid, even snow-white community, of tube and vase sponges, bryozoans and serpulid worm tubes.

So it is from the *MIDDLE SUBLITTORAL ZONE* that we can see long salients, bringing up privileged dark enclaves into the intertidal. I can think of a terrestrial analogy in English woodland flowers through spring and summer - in a succession of white, pale yellow, blue or mauve, red and finally golden yellow. In long salients from under the shaded woodland canopy, these flowers - celandine, cuckoo pint, bluebell, ragged robin - move out (like the items in partition-chromatography) at their own species rates along hedgerows traversing the open meadows.

What lies beyond the *MIDDLE SUBLITTORAL*? The same dark community continues in sufficient depths as at Poor Knights and Mimiwhangata. On a pallid ground colour, sponges are still there - with the scarlet points of brachiopods and cup corals. But now it is anthozoanns we begin to find dominating, with the mauve and puce and fawn sea fans (Gorgonians) - and snow-white thickets and shrubs of *Apanipathes,* (ineptly named "black corals").

There comes a break when the steep-plunging subtidal cliffs are finally cut off by the sediment line which is the inner edge of the continental shelf. The slope now gives place to a low-angled almost horizontal stretch. Here - as long as there is still rock a few centimetres under the surface - sediment-resistant sponges can still attach. We now find an outlandishly architected, dim-lighted landscape. Sponges grow in fans, candelabras, bowls, vases, golf-balls, tennis balls or low ground-crusts. All now in the subdued colours of brown, grey, buff or mauve.

Further out lies what? As sediment thickens, there remain only burrowing animals - especially bivalves and polychaete worms - with bottom-cruising and browsing fish. So we are seeing a changed and unearthly landscape. Not a single plant amongst its trees. With the loss of light and with no firm ground-base, there is hardly an item of interest for a botanist, and I have finally lost my tenuous excuse for talking to a Botanical Society - even in the hospitable dimensions of a Lucy Cranwell Memorial Lecture.

The Whau Creek

R. O. Gardner

I have been inspired by Dan Hatch's evocation of Laingholm's plants (Hatch, 1994) to write something about the place, also in West Auckland, where I grew up. Or more accurately, about its wildest frontier, which I knew as the Whau (pronounced ["Wow"]) Creek, though it seems that it should be called the Whau River from its mouth in the Waitemata Harbour up to just above the top of its tidal part, when it becomes the Avondale Creek, this a name I never heard used by any New Lynn-ite.

I start the description from where the Creek makes its closest approach to the Manukau Harbour, at Green Bay, the Creek being the line of the well known Maori portage. As is also well known, "The Whau", as the Avondale-Blockhouse Bay-New Lynn area was called, had no giant kauri to boast of,