

TWELVE READINGS ON THE LICHEN THALLUS

I. Face in the Mirror

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Figure 1. Brown-eyed Sunshine *Vulpicida canadensis*: fungal farmstead? Photo by Tim Wheeler.

Lichens are fungi that have discovered agriculture.

I REMEMBER IT WELL, that sunny autumn afternoon down in the canyon, about an hour from home. I'd been resting awhile under an old pine tree on a grassy hillside and, happening to look up, I noticed a brilliant yellow clump of *Vulpicida canadensis* clinging to a dead branch overhead. Lichenological sunshine.

Who can say why certain questions come to visit when they do? I know I can't. What I *can* say is that the existence of this particular lichen on this particular branch somehow struck me as deeply enigmatic. A lichen, after all, is part fungus and part alga, the first a denizen of the dark, the second a citizen of the moist. And yet here they were, a fungus and an alga, hanging out in lichen guise on a sun-bathed pine branch on one of the driest, least forgiving slopes in the Clearwater

Valley. And not just making do, mind you, but positively *thriving* – as witness all those big brown apothecia staring back at me. What kind of fungal-algal relationship could possibly make such a thing possible?

This wasn't the first time I had found myself asking questions of this kind. The best says-I-to-myself response I'd come up with to date was that a lichen must be a kind of fungal greenhouse, say an "elegant culture chamber for photobiont cells," as Rosmarie Honegger was later to put it. And yet I'm bound to admit this way of putting the matter never quite satisfied. Two reasons, I suppose. First because it seemed to give all the initiative to the fungus, none to the alga. And second because it implied a kind of genial environmental stability quite out of touch with

the wild climatic fluctuations that constitute the basic operating environment of most lichens – and that seem to be required for their establishment in the first place.

So anyhow there I was, nested on that particular grassy slope on that particular afternoon in late September, staring up at that particular lichen thallus: *Vulpicida canadensis*, Brown-eyed Sunshine (Figure 1). The only sound, I recall, was the sound of rushing water somewhere below. Then suddenly, out of nowhere, it came to me. Suddenly I had it, satisfactorily for the moment, and more or less problematically ever since. What I was looking at, the secret fraternity within the thallus, the thing staring me in the face, could really only be one thing: a kind of subsistence “farm,” in which an algal “crop” was tended by and in turn sustained a fungal farmer. Lichens, I decided, must simply be fungi that had discovered agriculture.

That was 1990. A few years later, in 1992, I floated my little epiphany in the popular field guide, *Plants of Coastal B.C.* No response. In 1993 I published it again, then in 1994 yet again, this time in slightly expanded form in an article for *Nature Canada*. Still nothing. In fact it wasn't until the late 90s (and thanks to Sylvia and Steve Sharnoff and their popular Lichens.com website) that the lichens-as-fungal-agriculture analogy began successfully to colonize the minds of lichenologists. In 2001 it found its way in into two papers: Vernon Ahmadjian's “*Trebouxia*: reflections on a perplexing and controversial lichen photobiont,” and William Sanders' lively piece on lichens as fungal “plants”. Since then it has been turning up all over the place, both within lichenology and outside of it – as for example in Don MacKay's *Vis-à-Vis* (a collection of essays on nature poetry), and in Richard Dawkins' *The Ancestor's Tale*.

All this would be gratifying in the extreme, except for one small detail. I no longer see the world – and lichens in particular – quite the way I saw it back in 1990. Nowadays I doubt if anybody would catch me describing lichens as agriculturally minded fungi. To be clear, it's not that I no longer think lichens are fungal farms – I find it hard to think of them any other way – rather it's that I no longer think of lichens as fungi. Fungal, yes. But fungi? I think not.

Here I need to introduce a certain age-worn analogy about a chocolate cake. A chocolate cake, of course, is made up of certain ingredients in due proportion: two eggs, a cup of flour, a half cup of milk, four table-spoons cocoa, and so forth. But few of us, if asked to describe a chocolate cake, would be likely to conjure

a thought bubble inhabited, for example, by two eggs, a cup of flour, a half a cup of milk, and four table-spoons cocoa. Almost certainly what would spring to mind would be the full meal deal: a cake: its form, texture, icing, taste. My point? Our tendency to think *cake* rather than *ingredients* is neither “correct,” nor is it otherwise. It's simply a matter of emphasis, of focus, a question of what perspective we bring to bear. Now try thinking fruit cake.

This brings me to the sixty thousand dollar question at the heart of this essay: Why do lichenologists find it so exceedingly difficult – imponderable might be a better word – to come up with a simple, clear definition of the word “lichen”? Certainly it's not for want of trying. Many definitions have been advanced over the years, but all have been found wanting. In this connection it's surely telling that the definition currently most in favour isn't a definition at all: “Lichen: an ecologically obligate, stable mutualism between an exhabitant fungal partner and an inhabitant population of extracellularly located unicellular or filamentous algal or cyanobacterial cells”. To me this reads more like a list of ingredients stirred around in the mixing bowl of “mutualism,” yet without ever being placed in the oven of process and properly *baked*. How on earth do we get from “obligate, stable mutualism” to Brown-eyed Sunshine?

Some would say lichens are hard to define because lichens aren't really a unified taxonomic group the way, for example, mosses are, or mammals, or for that matter chocolate cakes. In this view (embodied in the above definition) lichens are little more than ecological constructs: a dietary strategy adopted by about 15,000 disparate fungal species united only by a shared, rather particular kind of relationship to their algal and/or cyanobacterial foodstuff. Not only that, but one can also point to certain rather loose, crusty fungal-algal associations that don't quite seem fully “lichenized,” but that get studied by lichenologists in any event. How, goes the question, are we supposed to define what we're not even sure how to circumscribe?

Points taken. And yet for my money, the trouble with the lichen consortium has at least partly to do with its obvious multiple status: first as fungus, second as alga, and third as lichen *per se*. I'll have more to say on this subject in a future essay; but for now let me simply note that lichens are actually not the only organisms endowed with multiple identities of this kind. Not by a long way. So indeed is every eukaryotic life form alive today, or that has ever lived – our own precious selves included. Of course I'm referring here

both to the energy-giving mitochondria at the oxidative heart of the eukaryotic cell and, somewhat more apropos, to the chloroplasts of plants, including lichen algae, with their startling ability to convert the sun's energy to carbohydrates. The work of Lynn Margulis and others makes clear that both kinds of organelles – mitochondria and chloroplasts – started out as primitive, free-living bacteria that swam into the ancestral precursors of the eukaryotic cell, and never left. To this day, both retain portions of their original DNA and RNA, and both replicate after their own fashion. Seen from this perspective, the algae of lichens begin to look rather a lot like the chloroplasts of plants.

To me the real conceptual challenge posed by the lichen thallus derives from its unsettling capacity for transmutation even at the slightest shift in perspective. Some examples taken from the lichen literature might include: lichen as dietary strategy of certain fungi; lichen as ecological strategy of certain algae; lichen as controlled parasitism; lichen as mutualism; lichen as fungal agriculture; lichen as fungal greenhouse; lichen as gall; lichen as culture chamber; lichen as symbiotic phenotype; lichen as organism; lichen as ecosystem; lichen as emergent property. The list goes on.

It was Ludwig Wittgenstein, I believe, who famously called attention to the arresting incapacity of the human mind to entertain two perspectives simultaneously – as witness, for example, his drawing of the duck-rabbit (Figure 2). Toggle back and forth as often or fast as we like, and what comes into focus will always be one image or the other – a duck *or* a rabbit – never both together. Granted, the perceptual difficulties posed by the lichen consortium are of another kind – more conceptual than visual – yet Wittgenstein's drawing clearly gestures to a pervading feature of the human condition: our largely unconscious tendency to emphasize the single perspective over the multiple. How else, for example, are we to account for our species' universal (and not infrequently bellicose) allegiance to cultural identity?

Lichenologists working nowadays within reductionist traditions are naturally inclined to contemplate the lichen consortium in terms of its component parts, whether fungus or alga or cyanobacterium. Now stir in Wittgenstein's insight regarding our relation to perspective, and the century-long love affair between the lichenologist and the lichen fungus falls nicely into place. Granted it's not hard to justify (to ourselves at any rate) our current emphasis on the quantitatively dominant lichen fungus – at the expense, notice, not only of the photopartner, but more particularly of the

lichen as a whole. Still we would do well to consider the possibility that we have been predisposed to this emphasis at least in part by a seemingly tacit assumption that having majority status in terms of biomass confers upon the lichen fungus majority status in terms of function.

Yet is it really true, as certain leading lichenologists would have it, that the terms "lichen fungus" and "lichen" are synonymous; that the lichen fungus *is* the lichen? Recast this assertion within the frame of our chocolate cake analogy, and what comes out is something like saying chocolate cakes are synonymous with their main ingredient – flour I suppose. Such a statement could of course be a little hard to swallow; but even if we were to accept it, we'd still need to be clear that it has no truth value *per se*: in no way does it – or *can* it – have the authority of hard-won scientific knowledge. Consider this: that were the lichen alga positioned internal to the lichen fungus, rather than external to it, lichenologists would be much more inclined to give at least equal weight to its systems function as chloroplast. That done, the way would then be clear to acknowledging the lichen as an organism independent of its member parts. A workable definition, surely, would not be far behind.

It's sometimes said – with good reason, I think – that definitions can reveal as much about the people who posit them as about the things being defined. Next time you pause to contemplate Brown-Eyed Sunshine or the like, consider the possibility that what you think you see staring back at you – fungus, alga, thallus, parasitism, mutualism, agriculture, gall, growth chamber, farmstead – in some way reflects the mindset you bring to it; that what you're looking at is a kind of face in the mirror; and that the face in the mirror is very much your own.

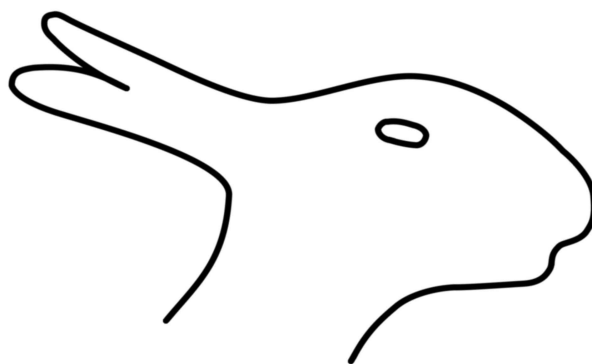


Figure 2. Duck-rabbit image