

Does Simple Clumping Explain the Origin of Multicellularity? A Creation-Model Assessment of Predator-Induced Multicellular Structures in Green Algae

Jerry Bergman, PhD ¹, Donny Budinsky ¹, Matt Nailor ¹

ABSTRACT

Laboratory evolution experiments in which the unicellular green alga *Chlamydomonas reinhardtii* forms cell clusters under predatory pressure are frequently cited as a direct observation of the origin of multicellularity. We review the most widely discussed of these studies and evaluate the claim against the biological requirements for complex multicellularity and against the predictions of a creation model. The evidence indicates that what was observed is the rapid, heritable expression of a pre-existing capacity for group formation, not the origin of the novel genetic machinery that differentiated multicellular life requires. The evolved clusters remain undifferentiated, lack division of labor, sacrifice motility, and draw on adhesion and extracellular-matrix genes already present in the algal genome and shared with its multicellular relatives. Comparable outcomes in other algae, in yeast, and in bacteria, together with recent work showing that group formation is frequently not adaptive, support the interpretation that these organisms carry engineered, environment-responsive programs for facultative aggregation. We argue that predator-induced clustering is better explained as designed phenotypic plasticity than as a macroevolutionary transition, and we set out the differing predictions of the evolutionary and creation models.

Keywords: multicellularity, *Chlamydomonas reinhardtii*, phenotypic plasticity, baraminology, extracellular matrix, engineered adaptability, origin of complexity

1. Introduction

The transition from single-celled to multicellular life is routinely described as one of the few pivotal events in the history of life, because it is held to have opened the door to the tissues, organs, and body plans of plants, animals, and fungi [1]. It is therefore unsurprising that when a normally unicellular alga can be induced in the laboratory to form clusters of cells within a year, the result is presented as evolution caught in the act, a completely novel origin of multicellularity in a lineage said to have had no multicellular ancestry [1]. The claim carries rhetorical force in debates over origins, and it is worth examining carefully and on its own terms.

A basic difficulty lies in the word itself. As Rose and Hammerschmidt observe, a loose microbial colony and an integrated organism such as an animal are not the same thing, and the term multicellularity is used for both [2]. Some definitions require only that cells form a group, while others require sustained physical contact, coordinated function, communication, and cooperation as a single unit [2]. On the stricter and biologically meaningful reading, multicellularity is the outcome of a developmental and organizational program, not merely the momentary presence of a clump [2]. The question we address is straightforward: does the observed clustering of algae under predation demonstrate the origin of that program, or does it demonstrate the expression of a capacity the organism already possessed?

We argue for the second interpretation. Below we describe what the experiments actually recovered, measure that result against the recognized requirements for complex multicellularity, and show that the genetic and comparative evidence points to a pre-existing, environment-responsive system rather than to the de novo assembly of new machinery. We then frame the observations within a creation model and state the contrasting predictions of the two positions.

2. What the Experiments Actually Found

In the most cited study, outcrossed populations of *Chlamydomonas reinhardtii* were cultured with the filter-feeding ciliate predator *Paramecium tetraurelia* [1]. Five experimental populations and three predator-free controls were transferred weekly for about 50 weeks, roughly 750 asexual generations. Two of the five predator-exposed populations produced heritable multicellular structures that were absent from the unselected controls, and survival assays confirmed that these clusters were harder for the predator to consume [1]. The evolved forms varied considerably in cell number and in the size of the propagules they released, and several formed an extracellular matrix in which dividing cells remained embedded [1].

Two features of the result deserve emphasis, because they are often lost in popular summaries. First, the authors themselves characterize the outcome as simple and undifferentiated multicellularity [1, 6]. No specialized cell types arose, no division of labor between a body and a reproductive line was established, and no developmental program building a defined organism was observed. Second, a comparable clustering response also appeared in one of the predator-free control populations [10]. If the presence of the predator were the cause of a genuinely novel trait, its appearance in a control undercuts that causal story and points instead to an internally regulated response that the predator merely favors.

A further detail is telling. The newly clustered strains largely lost effective phototaxis, the directional swimming by which free-living cells track light to optimize photosynthesis, even though the flagella of their component cells remained present and active [1]. In other words, the gain in protection came at the cost of a capacity the ancestor possessed. We take this trade-off seriously below, because a change that subtracts an existing function while switching on an available one is not obviously the kind of constructive, information-adding step that the evolutionary account of multicellular origins requires. We do not dispute that a heritable change occurred. The relevant question is what kind of change it was.

2.1 Scope and Evaluative Framework

This is a critical narrative review centered on predator selected *C. reinhardtii*. Settling selection in algae, snowflake yeast, comparative genomics, and phylogenetic reconstructions are considered where they clarify mechanisms or expose the limits of inference. The review distinguishes observation from historical interpretation and uses four levels of claim.

Table 1. The left shows each level followed by both minimum evidence and the status in the predator experiment.

Level	Minimum evidence	Status in the predator experiment
Temporary group formation	Cells remain together or aggregate under a condition.	Present in ancestral palmelloids and in some extracellular matrix bound forms.
Heritable obligate grouping	A stable genetic change makes a grouped life cycle persist without the original cue.	Present in several evolved isolates and maintained for years in culture.
Multicellular individuality	The group reproduces as a unit and group fitness becomes partly distinct from cell fitness.	Partly supported by clonal development and multicellular propagules in some isolates, but not comprehensively established.
Complex multicellular organization	Programmed cell types, spatial patterning, communication, division of labor, conflict control, and integrated organism level function.	Not demonstrated. The isolates were undifferentiated and lacked a new developmental hierarchy.

These levels form a claim ladder, not a semantic trick. Evolutionary transition researchers themselves distinguish cell groups, multicellular individuals, and multicellular organisms. Niklas and Newman similarly describe origination, integration, and autonomization as separate phases. The key dispute is therefore not whether more than one cell was present. The dispute is whether the experiment explains the organizational transition that makes complex multicellular life biologically distinctive.

The selected clusters survived predation better than unicellular strains. This is not a trivial result and should not be minimized. Larger units crossed a predator size threshold and gained protection. Selection changed the frequency of phenotypes and stabilized obligate grouping in some lines. A creation model that denies this observed adaptation would fail immediately. Biblical creation does not require biological immobility. It expects organisms to vary, adapt, and diversify within the capacities of their created organization.

3. The Definitional Gap: Simple Versus Complex Multicellularity

Biologists who study these transitions distinguish sharply between the simple grouping of cells and the complex, integrated multicellularity of plants and animals. On the standard multilevel-selection account, the origin of complex multicellularity requires the acquisition of cell-to-cell adhesion, intercellular communication, cooperation, and cellular differentiation, together with mechanisms that align the reproductive interests of the cells so that the group behaves as a single reproducing individual [3, 4]. Grosberg and Strathmann framed the problem as a major transition precisely because these requirements are demanding and interdependent rather than incidental [4].

The protection came with a major tradeoff. Multicellular isolates showed almost no effective phototaxis, even though their component cells retained active flagella. Boyd and colleagues reported that more than 99 percent of flagella were internalized, leaving the colony unable to move directionally. Phototaxis in unicellular strains was about ten times stronger on average. The defect was structural and organizational: individual parts still worked, but the cluster lacked the geometry and coordination required for organism level motility.

This is evidence of a real gain in one context and a real loss in another. It is not evidence that nothing happened. It is evidence that the change solved a narrow ecological problem by sacrificing an existing function. That pattern fits rapid adaptation through reconfiguration much more closely than it fits the origin of an integrated, higher order body plan.

Creationist analyses have made the same point independently. Doyle notes that a viable multicellular organism requires genetic sameness among its cells, a communication network that positions and regulates cell types, and an overarching level of intercellular coordination, embodied in a gene-regulatory hierarchy, that cannot be reduced to the properties of the individual cells. Cellular differentiation, guided by such a hierarchy, is ubiquitous in real multicellular organisms and is exactly what the algal clusters lack.

Measured against these criteria, predator-induced clumping meets almost none of them. The clusters are undifferentiated, they show no coordinated developmental program, they establish no soma and no dedicated germ line, and they persist only as long as daughter cells fail to separate. What the experiments demonstrate is the low end of a spectrum, the formation of a group, not the organizational achievement that the word multicellularity denotes in its strong sense. Calling the two by the same name, and then treating a demonstration of the first as evidence for the origin of the second, is the central equivocation in the evolutionary claim [17].

4. A Pre-Existing, Designed Capacity

The strongest positive evidence for the creation reading is that the capacity to form these groups was already present in the organism before any selection was applied. Clustered, matrix-embedded forms of this alga, known as palmelloids, were documented as a defense against rotifer predators well before the recent experiments, showing that the response is part of the organism's normal repertoire rather than a novelty [7]. The behavior is facultative and reversible under ordinary conditions. That is biologically meaningful. It is also precisely why the correct description is stabilization or genetic assimilation of an available program, not construction of the entire program from nothing.

The genetic work points the same way. The investigators themselves describe the multicellular phenotype as arising through the co-option of a previously existing plastic response, that is, a redeployment of machinery the cell already had, not the invention of new machinery [6]. Crucially, no account was offered of how the genes required for group formation, matrix production, or cohesion arose in the first place; they were simply already present to be switched on.

Comparative genomics reinforces this. The extracellular-matrix and adhesion genes used in clustering are shared between unicellular *Chlamydomonas* and its obligately multicellular relative *Volvox*, whose genomes are closely comparable in size, gene number, and domain content [8, 10]. The toolkit is a common property of the group.

The tempo of the change tells against a mutational origin as well. Novel multicellular structures appeared independently in separate cultures, and in a control, within roughly 750 generations [1, 10]. The de novo origination and coordinated assembly of a genuinely new genetic system in parallel, over such a short interval, would be an extraordinary claim. The rapid, repeatable, and parallel character of the response is instead the expected signature of a regulated program being triggered by an environmental cue, much as the same alga executes a large, coordinated shift in gene expression when carbon dioxide becomes scarce [10]. This is the pattern that Guliuzza has described as continuous environmental tracking, an engineered, sensor-driven adaptability in which organisms detect conditions and deploy pre-set responses, with the adaptive logic residing inside the organism rather than being imposed from outside [9].

5. One Created Kind, Two Phenotypes

If unicellular and multicellular volvocine algae share a common developmental toolkit, a natural creation-model expectation is that they belong to a single created kind, or baramin, expressing that toolkit differently. A baraminological analysis using whole-proteome gene-content comparison supports this: *Chlamydomonas reinhardtii*, the colonial *Gonium pectorale* of 8 to 32 cells, and the large spheroidal *Volvox carteri* cluster together as one statistically coherent group, distinct from other algae used as comparisons [10]. On this reading the single-celled and many-celled forms are alternative expressions of one original genome, a baranome, rather than the endpoints of an evolutionary ascent [10].

This framework also accommodates a possibility the evolutionary account resists. The differences between the forms are consistent with loss as readily as with gain. Certain genes active in *Volvox* development are quiet in *Chlamydomonas*, yet the *Chlamydomonas* versions can rescue the corresponding *Volvox* mutants, and the matrix-gene families are simply more numerous in the multicellular form [8, 10]. It is therefore coherent to propose that unicellular members are reduced descendants of multicellular ones, having lost or downregulated part of the shared program, a devolutionary trajectory that is far easier to explain than the construction of new information [10]. We present this as a hypothesis rather than a settled result, but it illustrates that the same data admit a reading opposite to the one usually asserted. Read this way, the obligate character of some evolved isolates, their apparent inability to revert to free-living cells, looks less like a step up in complexity and more like the loss of the switch that normally returns the cell to its solitary state.

6. The Same Pattern Across Many Systems

The algal result is not isolated, and the wider pattern favors the plasticity interpretation. Predation drove the green alga *Chlorella vulgaris* into stable colonies in an earlier experiment [11]; selection for rapid settling produced clustered snowflake forms in both *Chlamydomonas* and in brewer's yeast [12, 13]; and comparable facultative grouping occurs in bacteria under predator pressure. Facultative multicellularity, in short, is widespread, and simple multicellular forms are estimated to have appeared independently on the order of twenty-five times across the tree of life [14]. Even these systems remain far from complex multicellularity. The founding snowflake phenotype commonly arises through loss of the ACE2 transcription factor, which prevents normal mother and daughter separation. The long term lines became large and mechanically robust, but they remained a model of undifferentiated multicellularity. They demonstrate that selection can elaborate a clonal cluster. They do not show the origin of the many cell types and developmental control systems characteristic of complex organisms.

A recent and large study sharpens the point. Across 35 wild unicellular strains spanning 19 species, every environmental factor tested, including predation, induced the formation of multicellular groups, yet there was no evidence that the grouping itself was adaptive, since the proportion of cells in groups was not related to population growth under any condition [15]. Growth was instead tied to extracellular-matrix production and to palmelloid formation, both of which are features of the unicellular life cycle [15]. If the grouping response is not even reliably beneficial, it is hard to cast it as the raw material that natural selection assembled into complex organisms. It is far more naturally read as one setting of a flexible, pre-installed program. The same alga has also been shown, on phylogenetic analysis, to sit within a group in which multicellularity and differentiation appear multiple independent times, again consistent with a shared underlying capacity being expressed and lost rather than built from scratch [16].

7. Predictions of the Two Models

The dispute is not only about interpreting past data but about what each model expects future observation to show. The following predictions distinguish the evolutionary and creation accounts of these systems.

Observation	Neo-Darwinian expectation	Creation / design expectation
Genetic basis of clustering	Origin of new genes and regulatory circuits for adhesion and differentiation	Redeployment of adhesion and matrix genes already present in the genome
Speed and repeatability	Slow, contingent, and difficult to repeat, since it builds novelty	Rapid, parallel, and repeatable, since it triggers an existing program
Cell differentiation	Progressive division of labor toward soma and germ	Undifferentiated clusters; no new developmental hierarchy
Effect on prior function	Net gain in capability as complexity increases	Trade-offs and loss, such as reduced motility, alongside the gain
Relatives of the alga	A ladder from simple to complex built by accumulated novelty	One kind sharing a toolkit, expressed or lost across members
Adaptive value of grouping	Grouping is consistently favored as an adaptive innovation	Grouping is a flexible option, not always beneficial, as observed

On every line the observations reported to date fall on the creation-model side of the ledger, or are at best neutral between the two.

8. Discussion

We want to state the case fairly, including its limits. A real and heritable genetic change did occur in these experiments; the evolved strains are stable across thousands of generations even after the predator is removed [1]. Someone defending the evolutionary reading can point to that stability and to the fact that a life cycle was altered. We grant this. Our contention is narrower and, we think, decisive: stability and heritability establish that a change was fixed, not that new organizational information was created. The machinery drawn upon, adhesion, matrix, and the plastic grouping response, was demonstrably present beforehand and is shared with the organism's multicellular relatives [6, 8, 10]. What changed was the setting of a switch, not the invention of the circuit.

It is worth naming what would count as evidence for the stronger claim. If an initially unicellular lineage were observed to originate, *de novo*, the genes for a genuine developmental program, to establish a reproducible division of labor between distinct cell types, and to build the gene-regulatory hierarchy that coordinates them, that would be a serious challenge to the creation model, and we would say so plainly. Nothing of the kind has been reported. What has been reported is undifferentiated clustering that recurs easily, in parallel, and sometimes without any predator at all. The comparative and fossil record leaves the evolutionary account no easier. As the same review that supplies the careful definition of multicellularity concedes, for most groups there is little or no fossil evidence bearing on the first steps of the transition, intermediate forms between multicellular organisms and their unicellular relatives are lacking, and living unicellular species used as stand-ins for ancestors are only a poor approximation [2]. The origin of complex multicellularity remains, on the mainstream telling, largely unobserved and unexplained. Into that gap the algal experiments have been pressed as a proxy. They cannot bear the weight, because they document a different and lesser phenomenon.

9. Conclusion

The predator selected *Chlamydomonas reinhardtii* is not a failed experiment. It is a successful experiment whose meaning has been exaggerated. Two of five selected populations, and zero of three controls, produced heritable multicellular structures after about 750 generations. Several isolates became obligately multicellular and survived predation better. Yet they remained undifferentiated, lacked coordinated colony motility, relied on cell retention and matrix capacities already present in the lineage, and paid for protection with loss of effective phototaxis. A 2025 experiment made the constraint even clearer: every multicellular isolate came from only two of ten founders. Every one of these features is anticipated by a model in which living things were designed with flexible, environment responsive programs for facultative grouping, and each sits awkwardly with a model that must build such programs from scratch. We conclude that the algae, in the memorable phrase, find safety in numbers by design. The observed data are better read as the expression of engineered adaptability within a created kind than as a macroevolutionary transition from single-celled to complex multicellular life.

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