State of LA Fungi

April 25, 2023

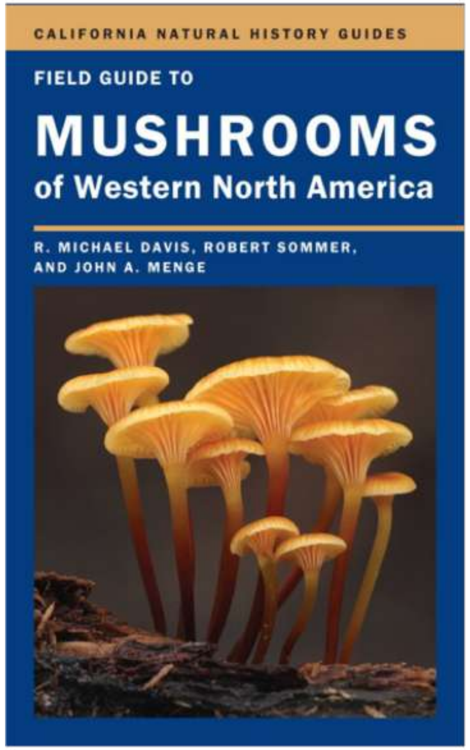
Chlorophyllum rhacodes

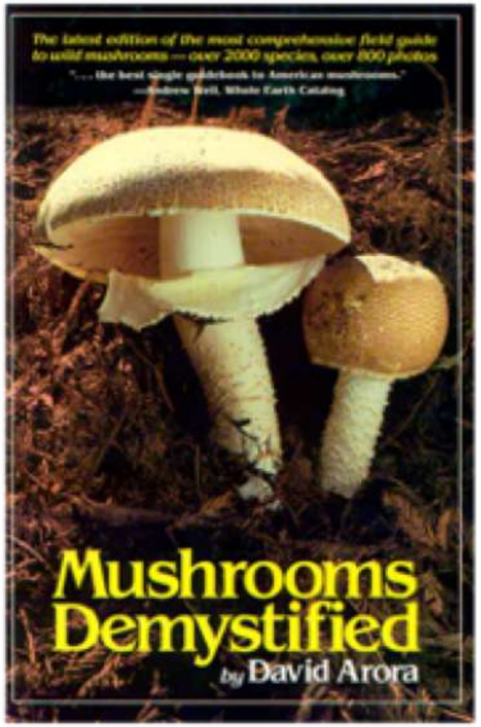
Los Angeles Mycological Society

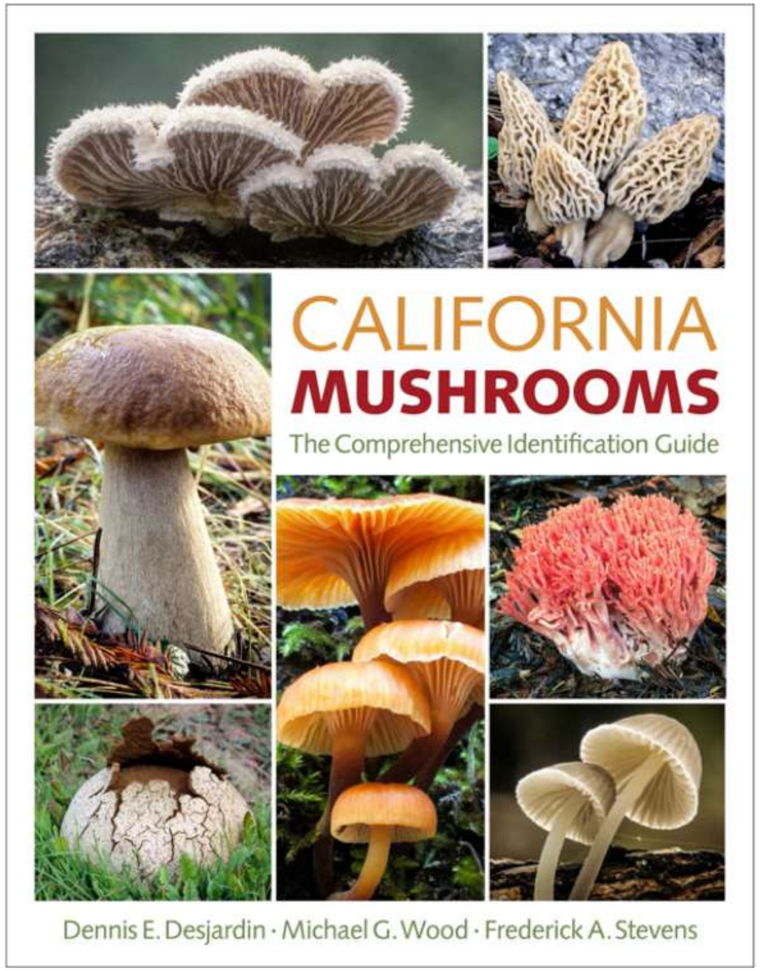
I. Interesting April finds

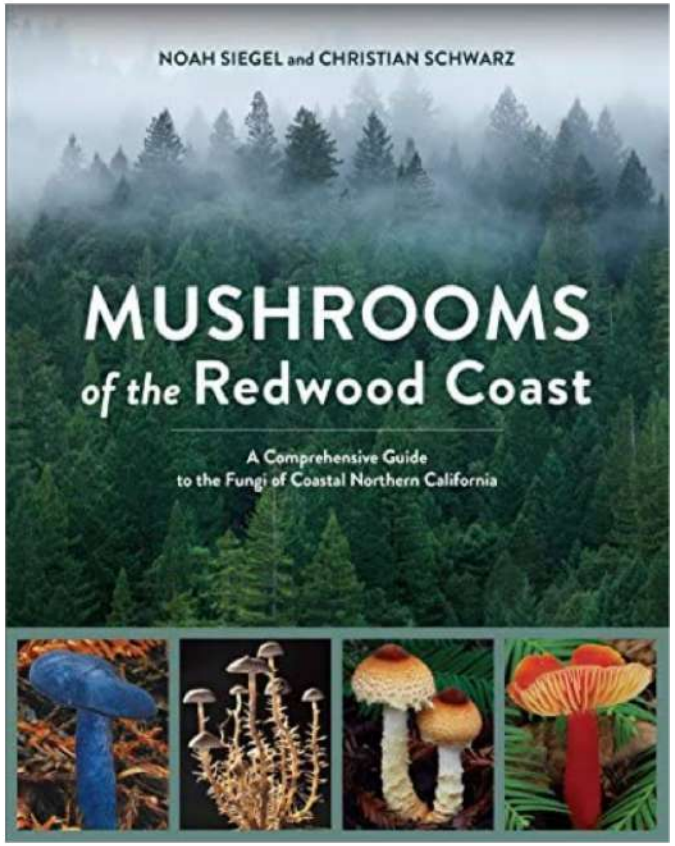
II. Incident of the house-eating fungus in Orange County

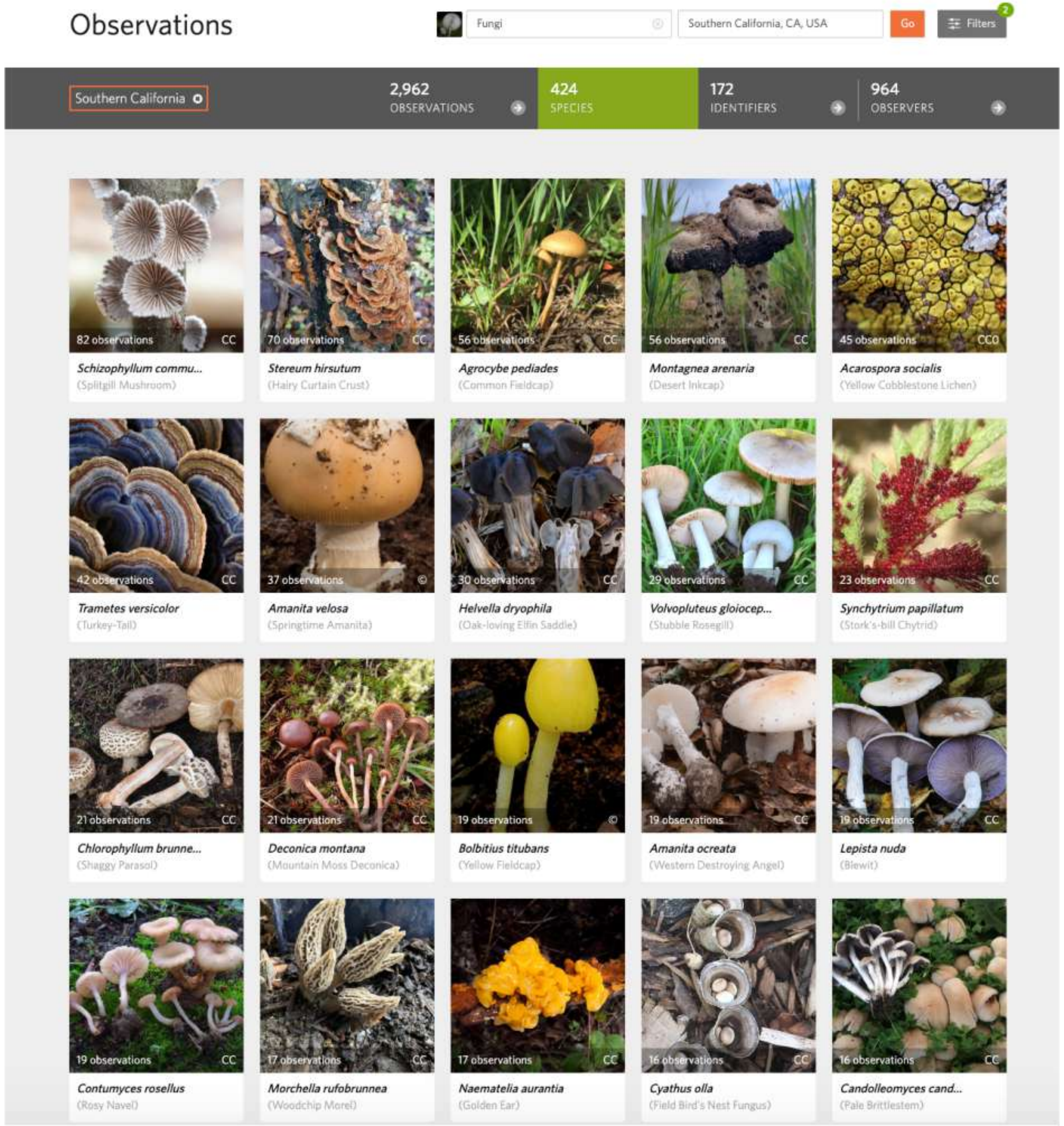
III. On form, development, and repeated evolution


CALIFORNIA NATURAL HISTORY GUIDES
FIELD GUIDE TO
MUSHROOMS
of Western North America
R. MICHAEL DAVIS, ROBERT SOMMER, AND JOHN A. MENGE


The latest edition of the most comprehensive field guide to wild mushrooms — over 2000 species, over 800 photos
Mushrooms Demystified
by David Arora

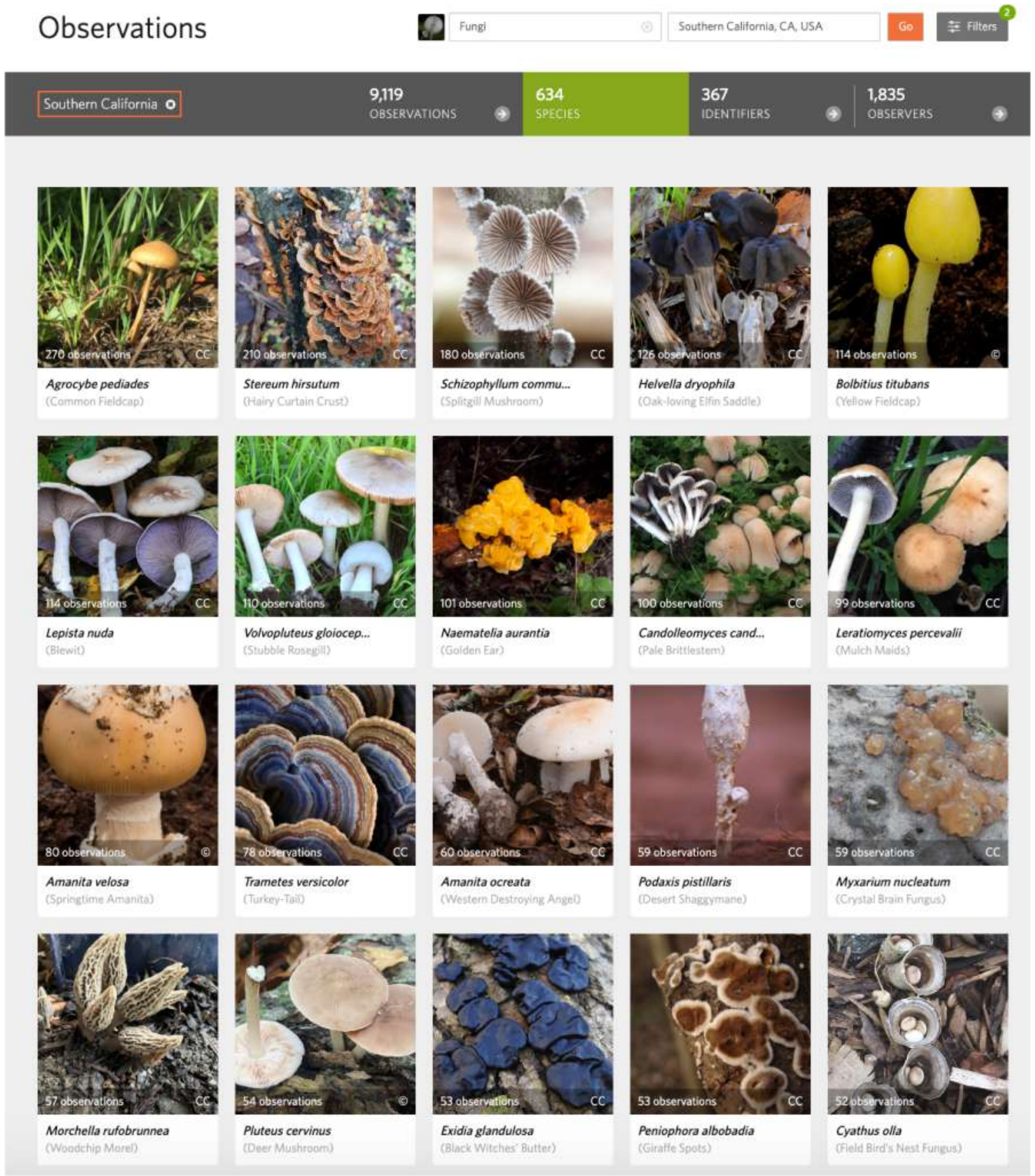

CALIFORNIA MUSHROOMS
The Comprehensive Identification Guide
Dennis E. Desjardin · Michael G. Wood · Frederick A. Stevens


NOAH SIEGEL and CHRISTIAN SCHWARZ
MUSHROOMS of the Redwood Coast
A Comprehensive Guide to the Fungi of Coastal Northern California



iNaturalist: Most Common Fungal Species in SoCal, April 2023

https://www.inaturalist.org/observations?d1=2023-04-01&d2=2023-04-25&place_id=51727&taxon_id=47170&view=species



Compare to March 2023

https://www.inaturalist.org/observations?d1=2023-03-01&d2=2023-03-31&place_id=51727&taxon_id=47170&view=species

TRUFFLES (*Tuber* spp.)

SP

With *Adenostoma fasciculatum* (chamise)

SP

With *Quercus chrysolepis* (canyon oak)

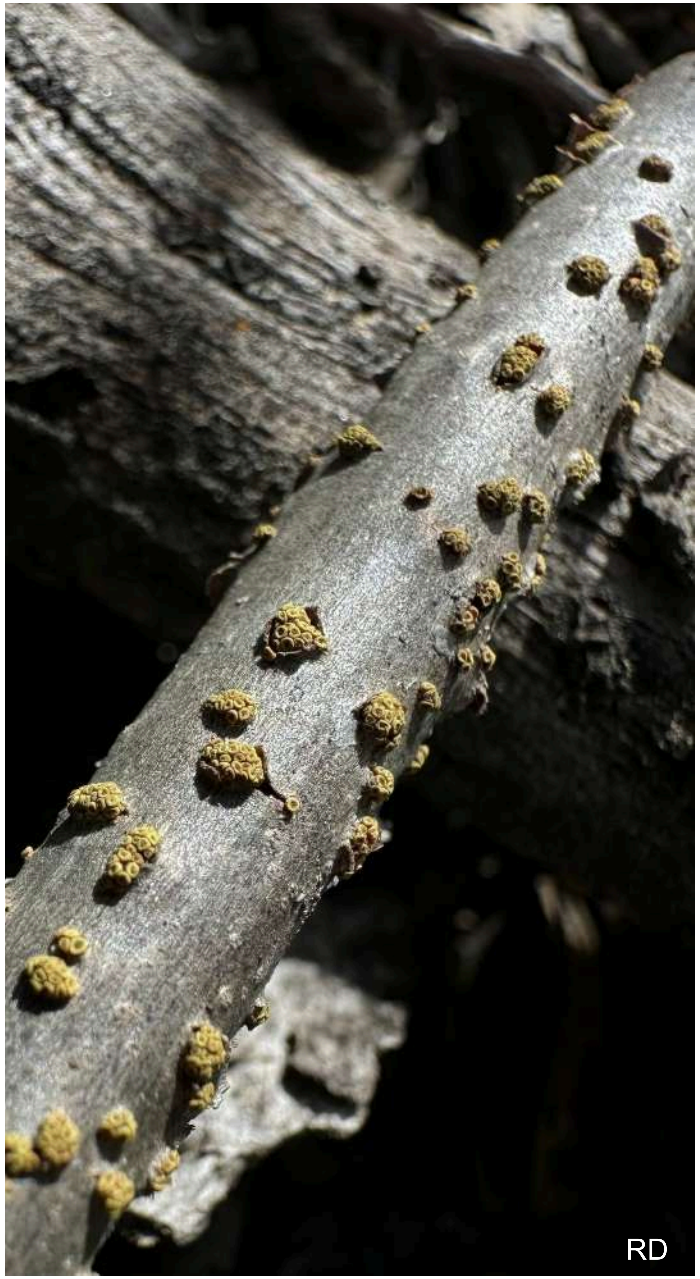
RD

With *Quercus berberidifolia* (scrub oak)

I II III

RD

Balloon-like ascus with ascospores.

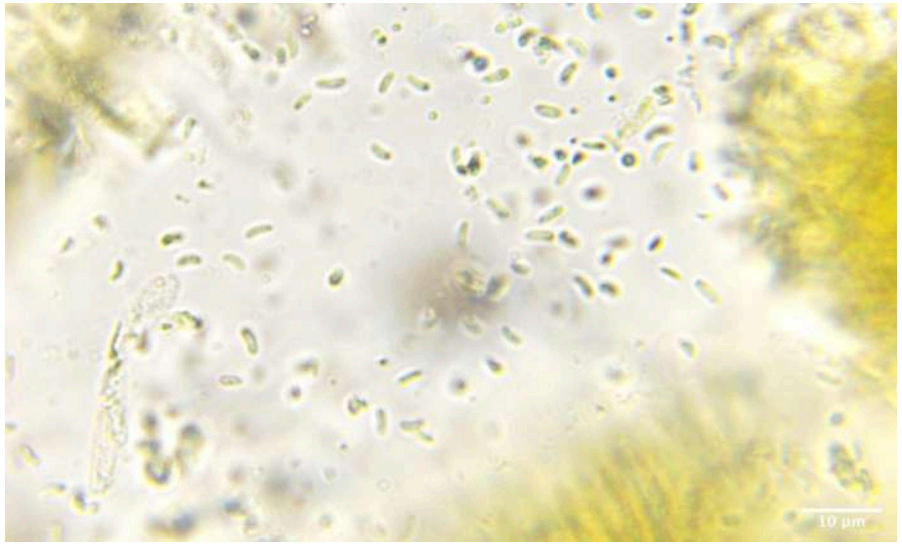


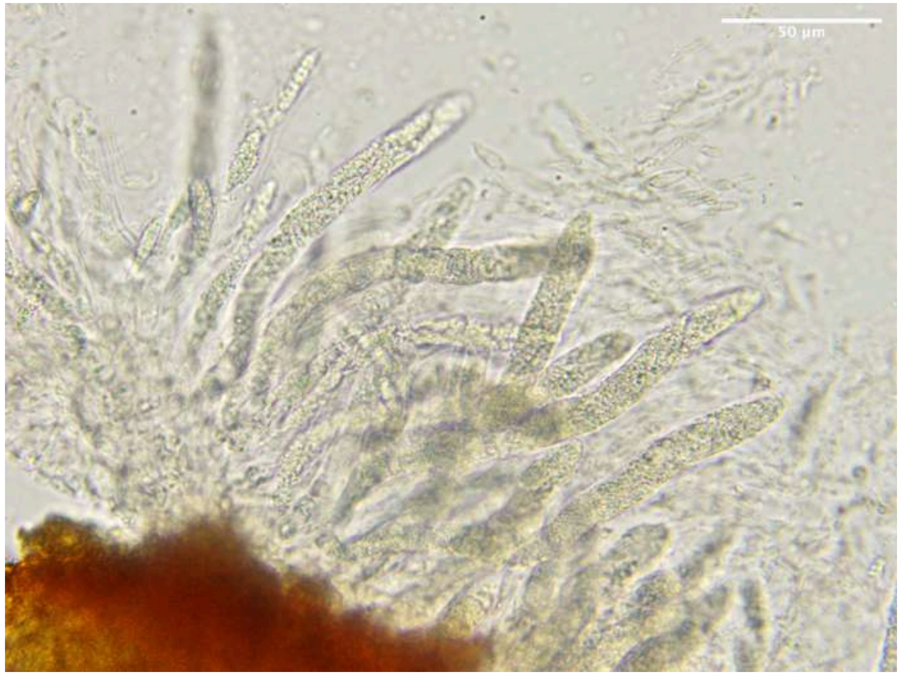
Thyronectria sp.

Nectriaceae, Hypocreales, Sordariomycetes

On Ribes indecorum
white chaparral currant).

I II III



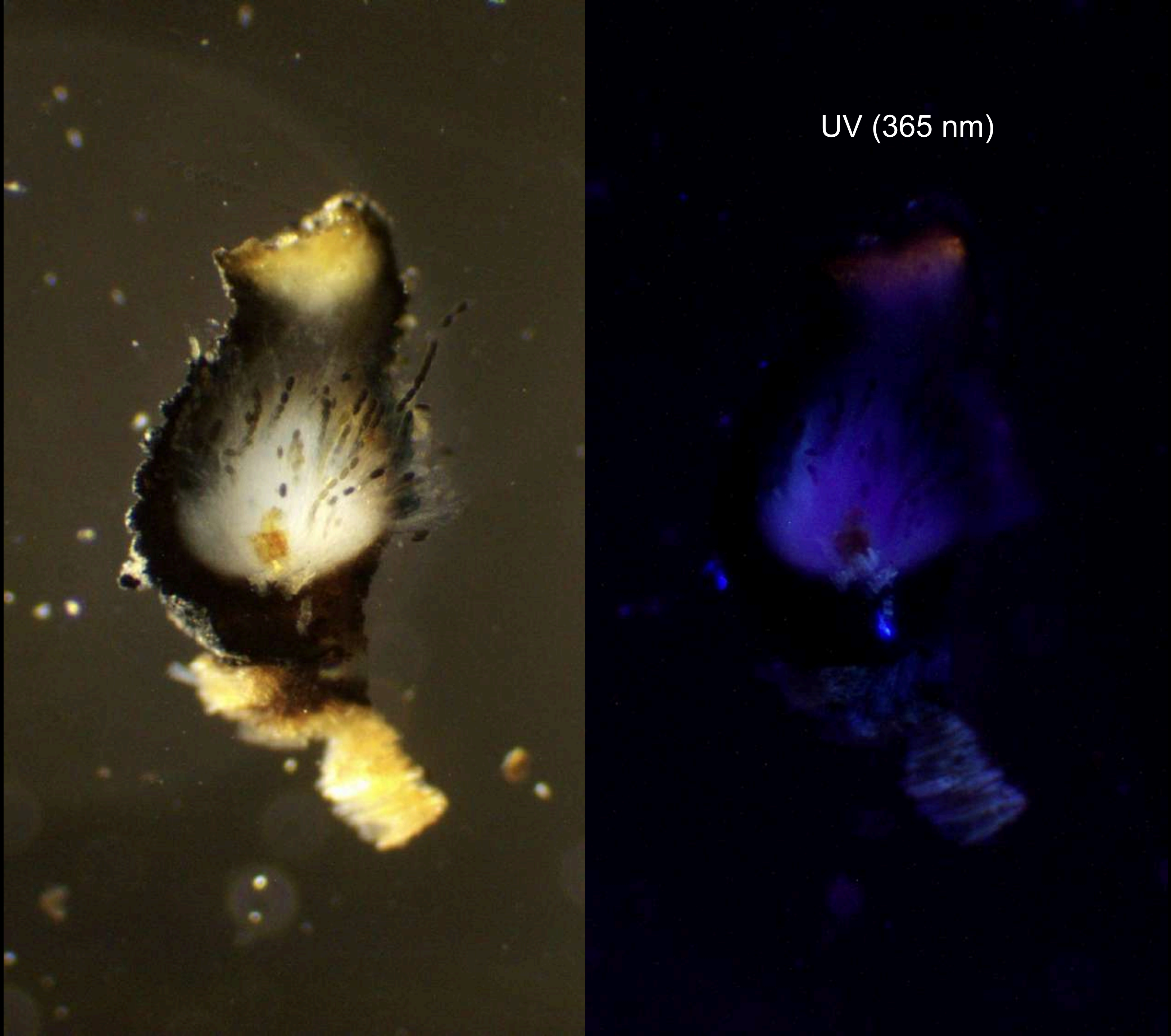


I II III

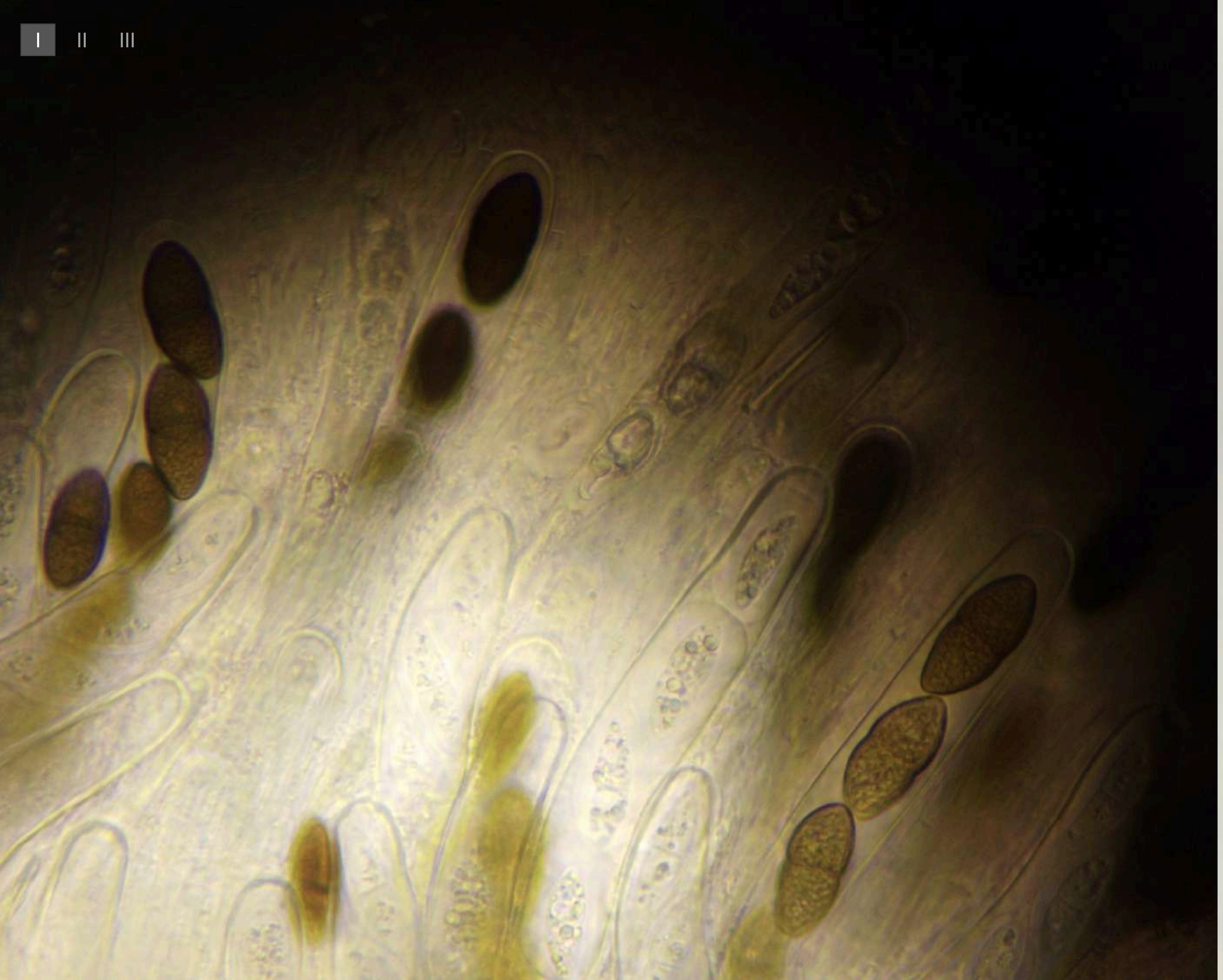
Cucurbitaria sp.

Cucurbitariaceae, Pleosporales, Dothidiomycetes

On Rhamnus ilicifolia (hollyleaf redberry).


UV (365 nm)

I II III



I II III

Incident of the house-eating fungus (*Meruliporia* ‘poria’ *incrassata*) in Huntington Beach.

Photos courtesy of homeowner Mike F.

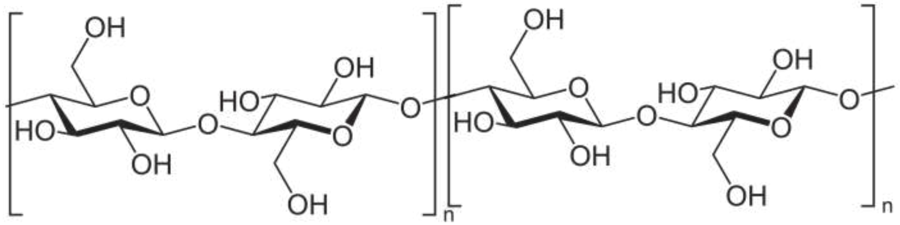
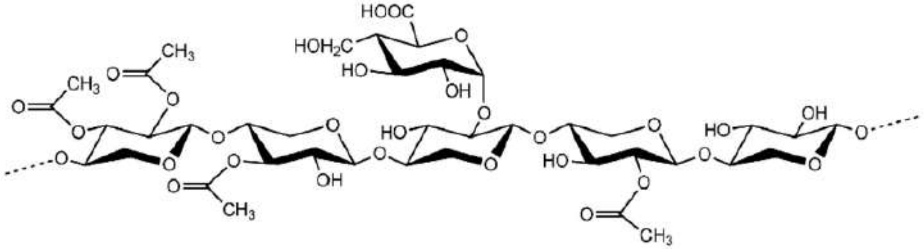
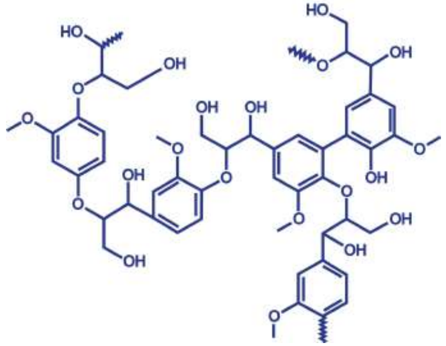

MF

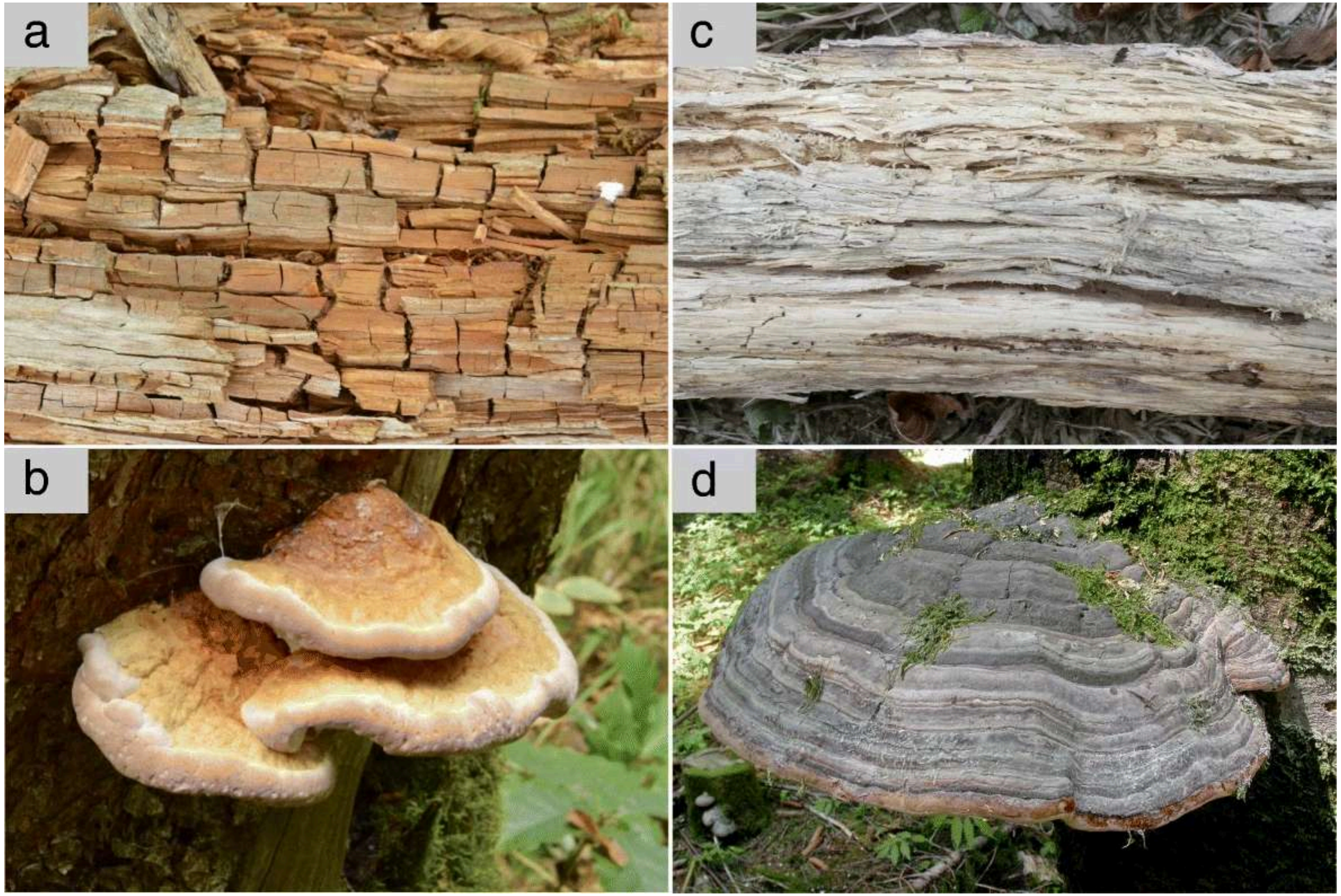
Requirements for fungal growth:

- Favorable temperature (~32 to ~105 °F)
- Atmospheric oxygen
- Supply of water
- Digestible carbon compounds (the food)

Wood Microbiology, 1992, Zabel & Morrel

Three types of polymers are the principal constituents of wood:

		Brown rot	White rot
Cellulose		X	X
Hemicellulose		X	X
Lignin			X



Brown and white rot residues and fungal fruit bodies. **a**) Brown rot residue, **b**) brown rot fungus, *Fomitopsis pinicola* (Polyporales, Fomitopsidaceae), **c**) white rot residue, **d**) white rot fungus, *Fomes fomentarius* (Polyporales, Polyporaceae). Photos by F.-S. Krah (**a**,**b**,**c**) and Heinrich Holzer (**d**)

Krah, FS., Bässler, C., Heibl, C. *et al.* Evolutionary dynamics of host specialization in wood-decay fungi. *BMC Evol Biol* **18**, 119 (2018). https://doi.org/10.1186/s12862-018-1229-7

I II III

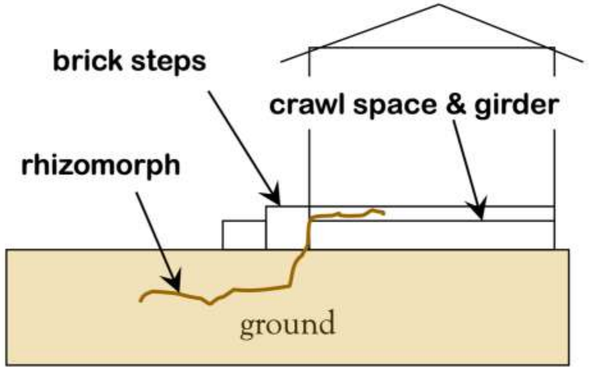
“brown rot fungi are generalists or gymnosperm specialists, whereas most white rot fungi are angiosperm specialists.”

Krah, FS., Bässler, C., Heibl, C. *et al.* Evolutionary dynamics of host specialization in wood-decay fungi. *BMC Evol Biol* **18**, 119 (2018).
https://doi.org/10.1186/s12862-018-1229-7

The most commonly used woods in construction are softwoods.

Water-conducting rhizomorph.

A leak in the house is not required for the fungus to access water (hence, “dry rot”).



Stephen L. Quarles

I II III

Early-developing fruit body.

http://www.blackmould.me.uk/Meruliporia%20incrassata.html

Structure of mature fertile surface.

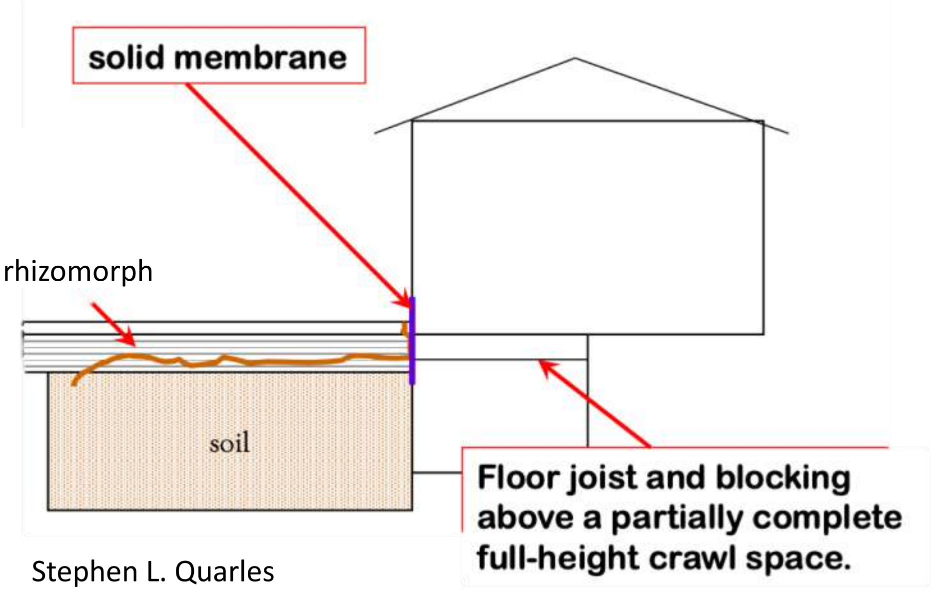
The solution?

In addition to replacing all the damaged wood,

> *"sever all rhizomorphs entering the building, and modify the construction detail to prevent entry of other rhizomorphs in the future."*

Stephen L. Quarles

http://cdnassets.hw.net/54/d9/7f1f61984e02812de579c2aeb5e1/172688.pdf



Stephen L. Quarles


INSIDE:
MIKE FOWLER
VS.
THE HOUSE EATING FUNGUS
ADMISSION AT THE DOOR
FUN GUY
IN BETWEEN ROUNDS

I II III

M. incrassate – *Meruliporia* – Serpulaceae – Boletales

species genus family order

I II III

On form, development, and repeated evolution.

© Nathan Wilson

Xerocomellus dryophilus,
a bolete.

© Steve Trudell

Phylloporus arenicola,
a gilled bolete.

© Fred Stevens

Rhizopogon occidentales,
a gasteroid bolete.

https://commons.wikimedia.org/wiki/File:Leaves-scan.jpg

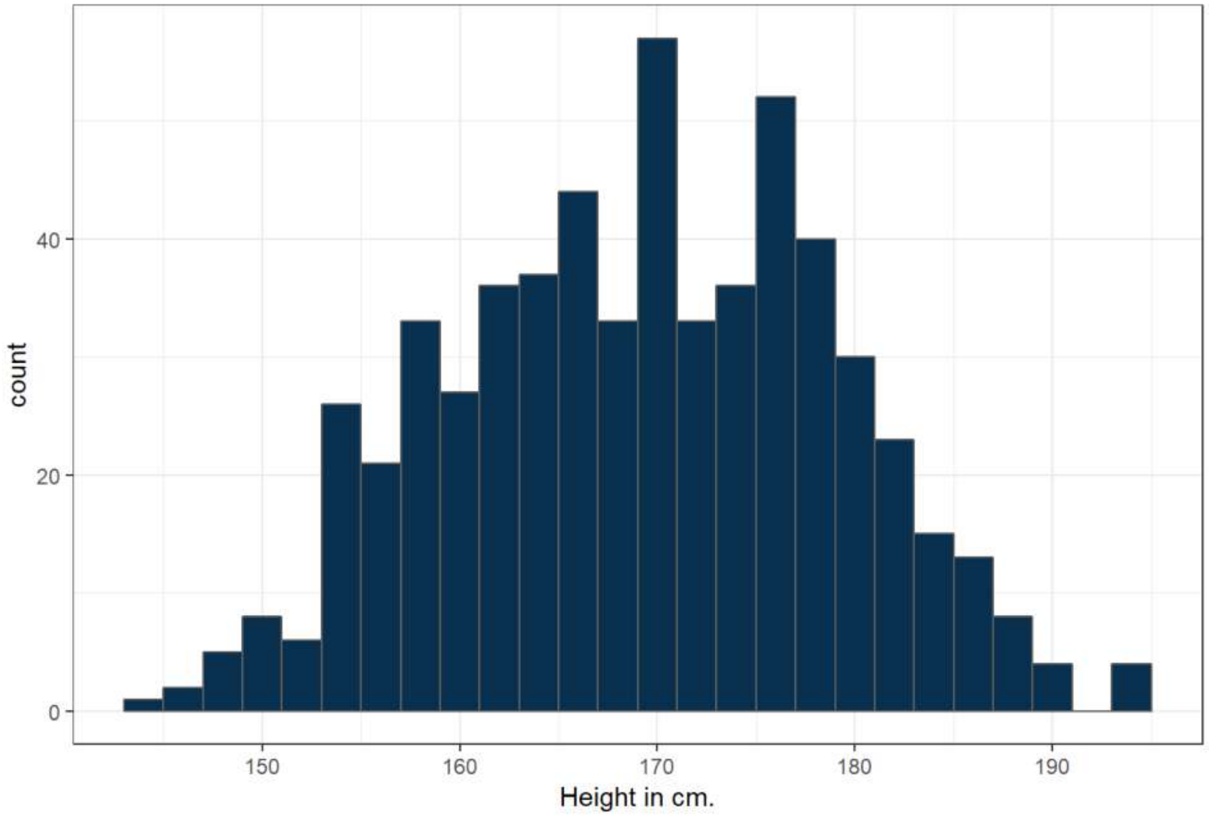
“Form” and reality.

Is there a “perfect” leaf?

I II III

Is there an "average" person?

Heights of subjects ages 21-79.

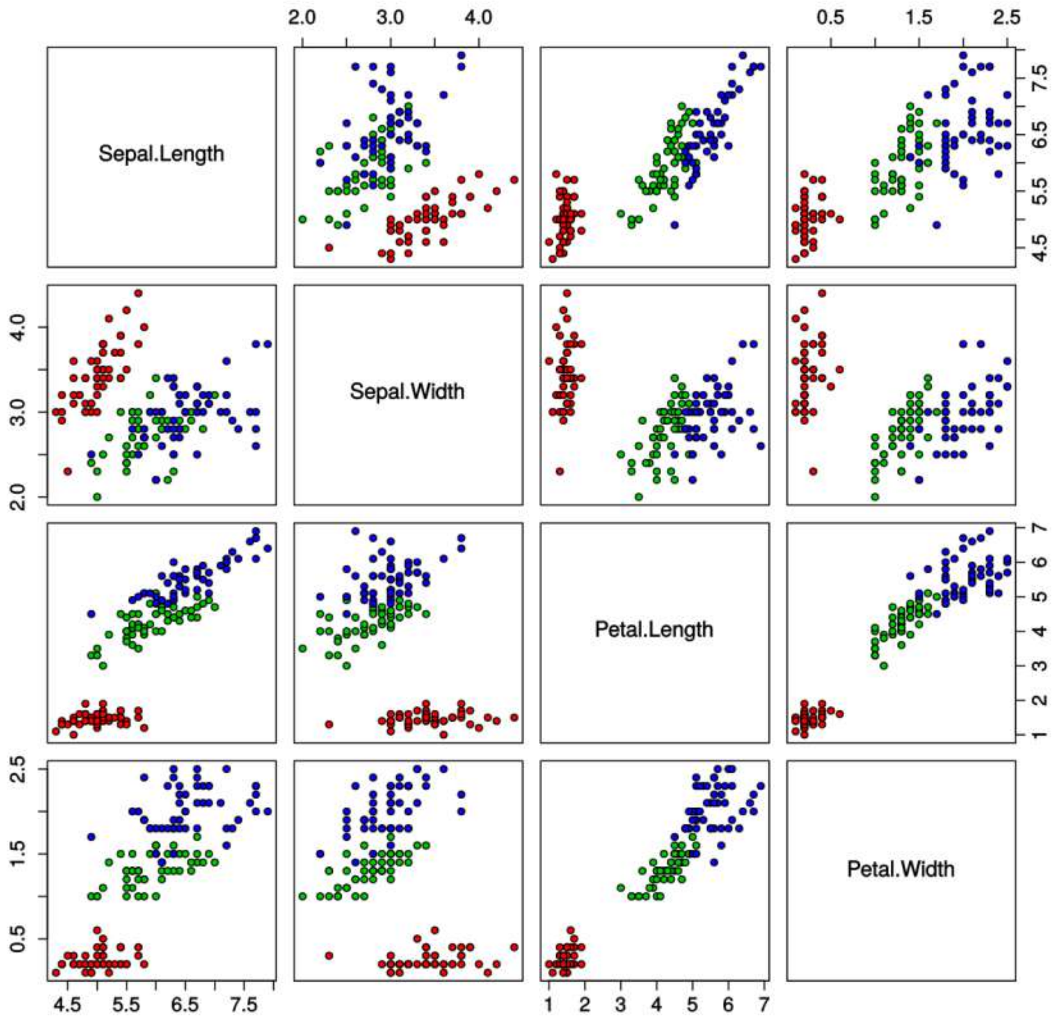


Baumer, Benjamin S., Daniel T. Kaplan, and Nicholas J. Horton. 2017. *Modern Data Science with R*.

The contrast between Plato and Darwin's biology:

organisms as "***types***" vs. organisms as "***instances***"

I II III

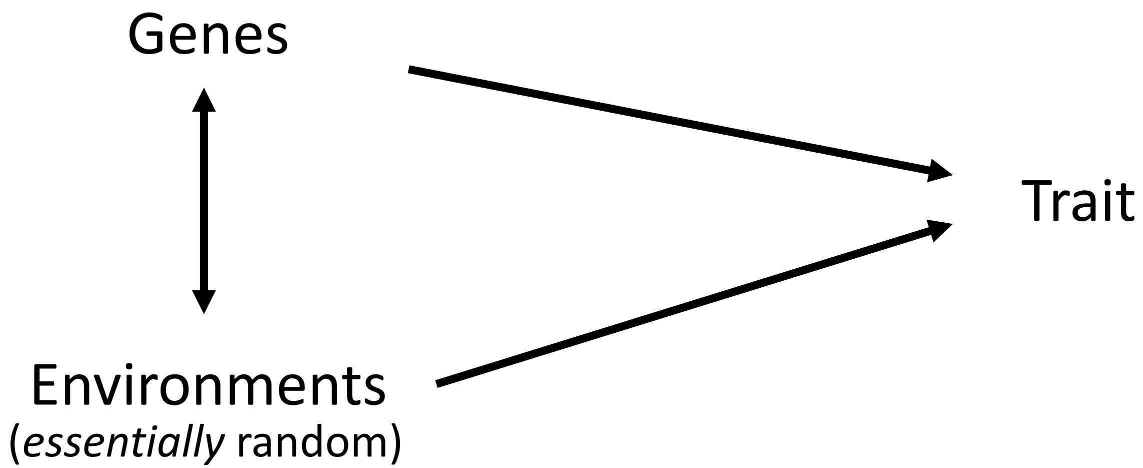


Fisher and Anderson's Iris data set (1936).
I. setosa (red); *I. versicolor* (green); *I. virginica* (blue).

There is no canon,
only variation and central tendency.

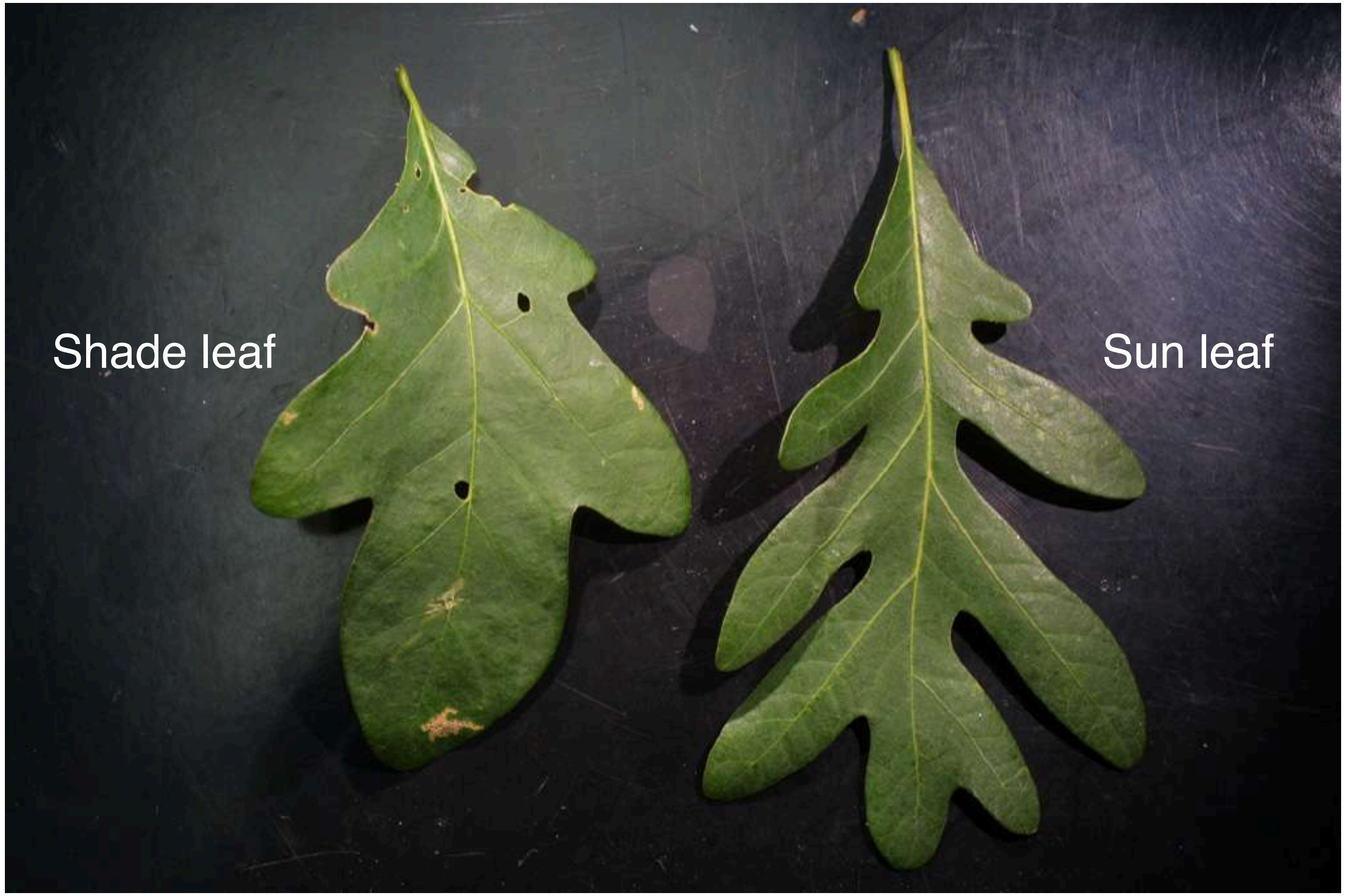
I II III

Why? Because the genetic control of biological traits is not predetermined.



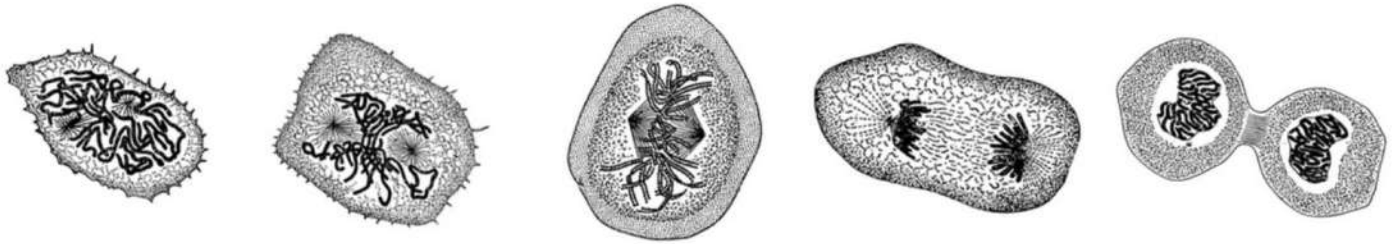
I II III

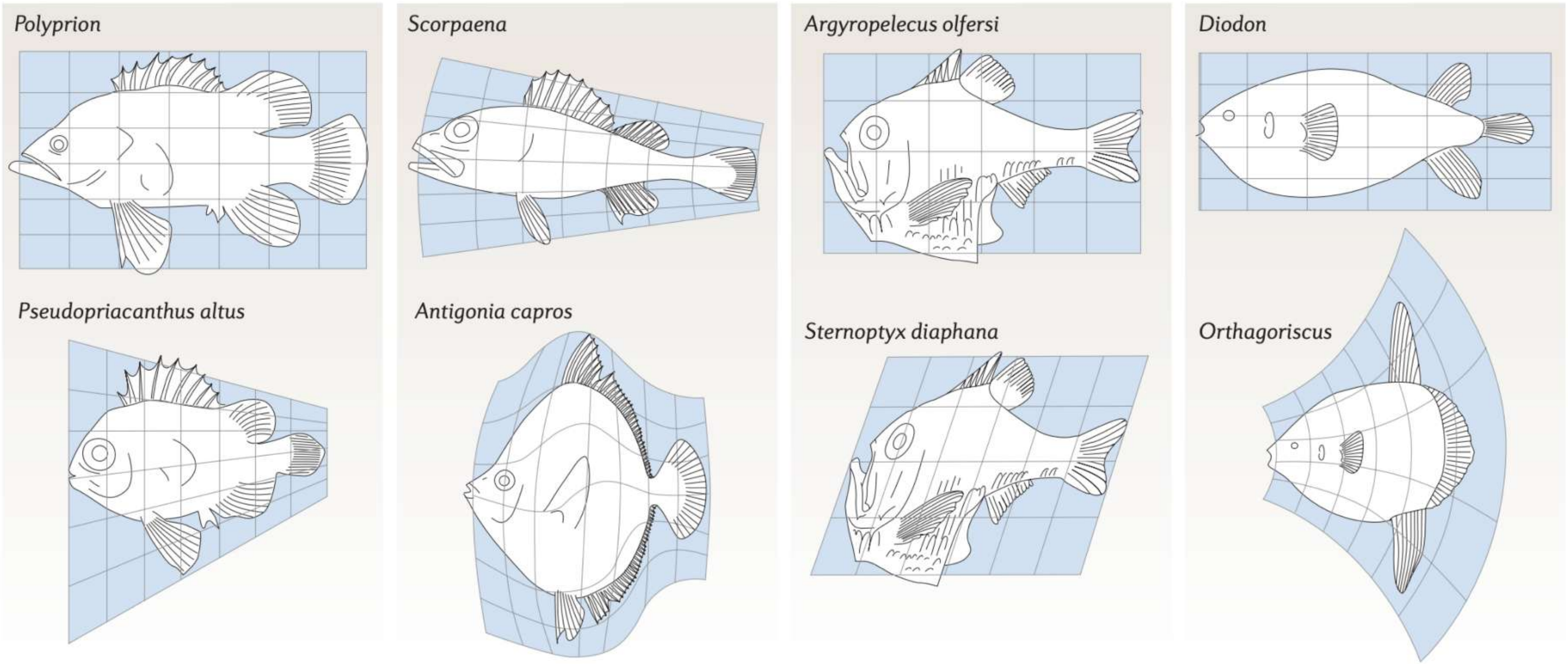
Leaves from the same tree.



http://bioimages.vanderbilt.edu/baskauf/12516.htm

Development (or ontogeny): Organism as historical construction.





On Growth and Form, D'Arcy Wentworth Thompson (1917)

I II III

Published: 11 April 2006

D'Arcy Thompson and the theory of transformations

Wallace Arthur

Nature Reviews Genetics **7**, 401–406 (2006) | Cite this article

An Erratum to this article was published on 01 June 2006

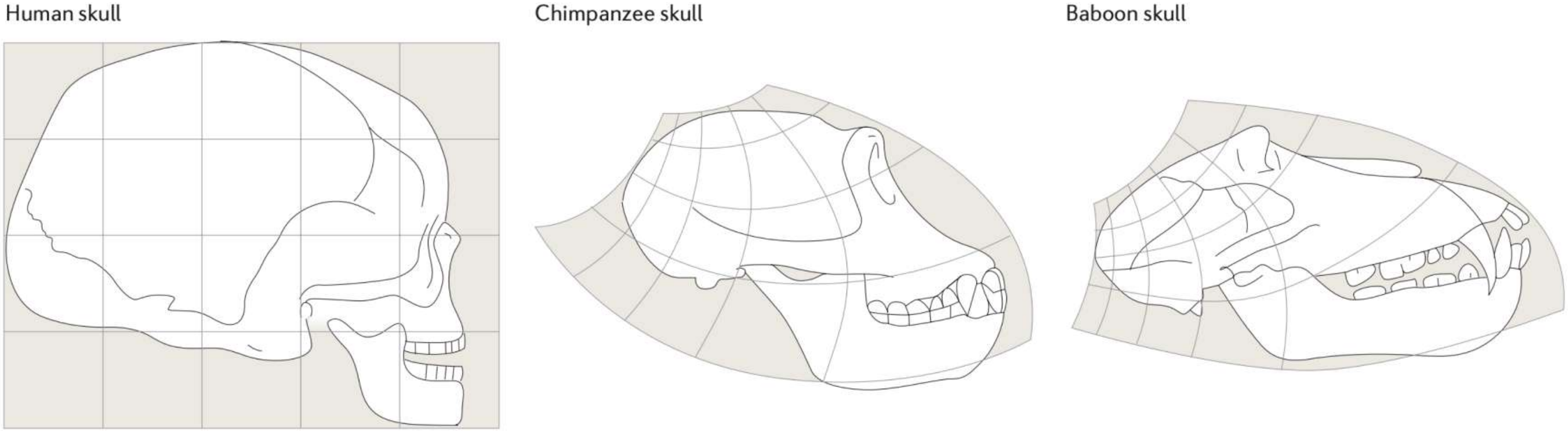
Abstract

D'Arcy Thompson was a biologist, a mathematician and a classicist. His writing was great literature as well as great science. He is primarily known for a single book – *On Growth and Form* – and indeed for a single chapter within it, on his 'theory of transformations', which shows how the differences between the forms of related species can be represented geometrically. This theory cries out for causal explanation, which is something the great man eschewed. Perhaps the time is close when comparative developmental genetics will be able to provide such an explanation.

https://www.nature.com/articles/nrg1835

I II III

https://www.betterbred.com/2019/12/19/whats-enough-diversity-in-a-breed/



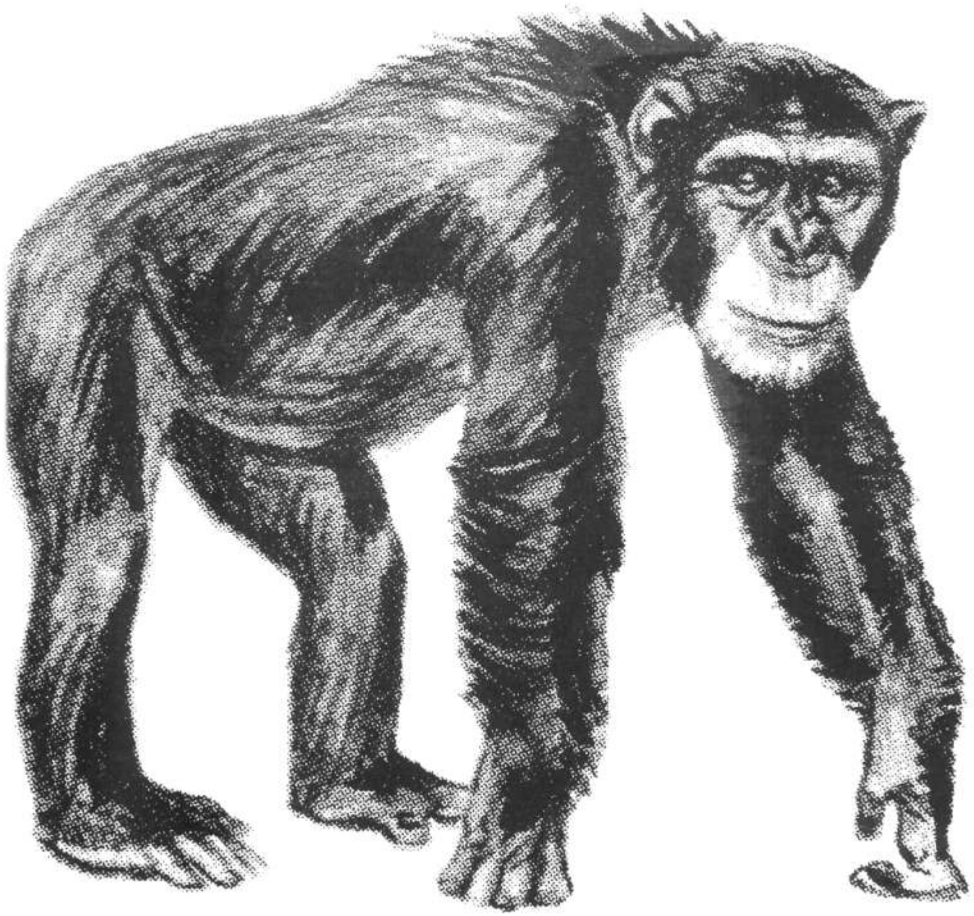
Geometric transformations to relate human, chimpanzee, and baboon skulls
(Arthur 2006, per Thompson 1917).

Reprinted from
11 April 1975, Volume 188, pp. 107-116

SCIENCE

Evolution at Two Levels in Humans and Chimpanzees

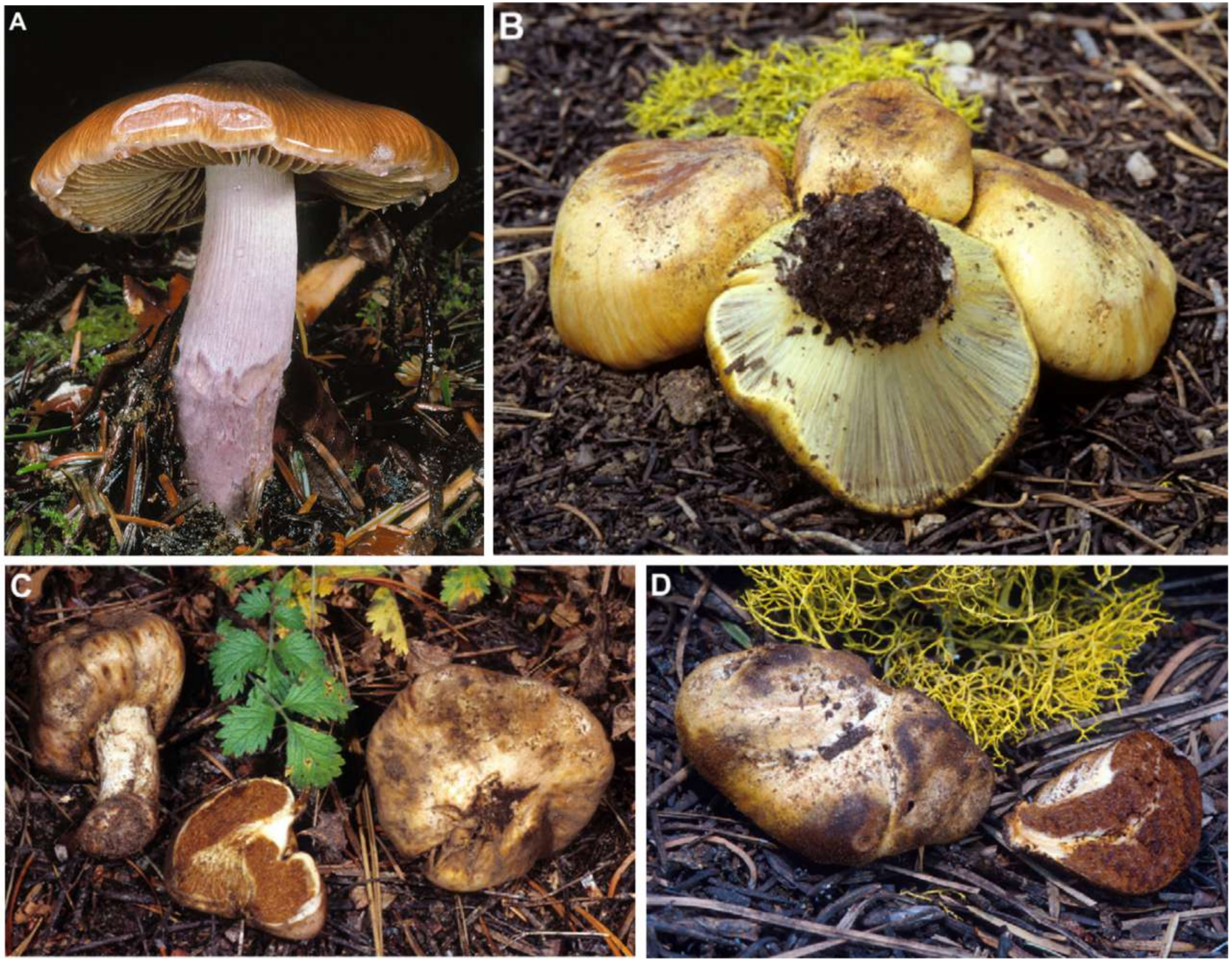
Mary-Claire King and A. C. Wilson



Polypeptide sequencing enabled the landmark discovery that humans and chimpanzees share 99% identity in

King, M. C. & Wilson, A. C. Evolution at two levels in humans and chimpanzees. *Science* **188**, 107–116 (1975)

I II III



Fruiting body forms in Cortinariaceae.

(A) *Cortinarius vanduzerensis*, a fully epigeous agaricoid form with an ephemeral cortina (partial veil, not visible here). (B*) C. verrucisporus*, an ‘emergent’ agaricoid form with a persistent veil. (C) *Thaxterogaster pingue*, a secotioid form. (D) *Hymenogaster sublilacinus*, a hypogeous gasteroid form. (A) a Taylor Lockwood; (B–D) a Michael Wood.

Hibbett, D. *Mycol. Res.* **111**, 1001–1018 (2007)

MYCOLOGICAL RESEARCH 111 (2007) 1001–1018

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bms British Mycological Society promoting fungal science

journal homepage: www.elsevier.com/locate/mycres

Mycological Research

After the gold rush, or before the flood? Evolutionary morphology of mushroom-forming fungi (*Agaricomycetes*) in the early 21st century☆

David S. HIBBETT

Biology Department, Clark University, Worcester, MA 01610, USA

A R T I C L E I N F O

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Development
Fruiting body
Phylogeny

A B S T R A C T

Mushroom-forming fungi (*Agaricomycetes*, approx. syn.: *Homobasidiomycetes*) produce a diverse array of fruiting bodies, ranging from simple crust-like forms to complex, developmentally integrated forms, such as stinkhorns and veiled agarics. The 19th century Friesian system divided the mushroom-forming fungi according to macromorphology. The Friesian taxonomy has long been regarded as artificial, but it continues to influence the language of mycology and perceptions of fungal diversity. Throughout the 20th century, the phylogenetic significance of anatomical features was elucidated, and classifications that departed strongly from the Friesian system were proposed. However, the anatomical studies left many questions and controversies unresolved, due in part to the paucity of characters, as well as the general absence of explicit phylogenetic analyses. Problems in fruiting body evolution were among the first to be addressed when molecular characters became readily accessible in the late 1980s. Today, GenBank contains about 108,000 nucleotide sequences of 'homobasidiomycetes', filed under 7300 unique names. Analyses of these data are providing an increasingly detailed and robust view of the phylogeny and the distribution of different fruiting body forms across the 14 major clades that make up the agaricomycetes. However, it would be wrong to suggest that all the important questions about fruiting body evolution have been resolved. Recent studies focusing on resupinate forms suggest that there may still be undetected major clades of agaricomycetes, which could have a significant impact on our estimates of the ancestral forms in this morphologically diverse group. Modern approaches, including comparative phylogenetic analyses and developmental studies, have the potential to yield novel insights into both the macroevolutionary processes and cellular mechanisms of fungal morphological evolution.

https://www.sciencedirect.com/science/article/abs/pii/S0953756207000160?via%3Dihub

Evolutionary developmental biology

From Wikipedia, the free encyclopedia

Evolutionary developmental biology (informally, **evo-devo**) is a field of biological research that compares the developmental processes of different organisms to infer how developmental processes evolved.

I II III

Table 1 – Distribution of fruiting body forms across 14 major clades of agaricomycetes, with selected exemplars (names in parentheses deviate from typical forms)

	Agaricales	Atheliales	Auriculariales	Boletales	Cantharellales	Corticiales
Pileate-stipitate						
Lamellate	*Agaricus bisporus* *Amanita muscaria* *Coprinus comatus*			*Hygrophoropsis aurantiaca* *Phylloporus rhodoxanthus* *Tapinella atrotomentosa*	(*Cantharellus cibarius*)	
Poroid	*Poromycena manipularis*			*Boletus edulis* *Suillus pictus*		
Hydnoid					*Hydnum repdnum* *Sistotrema confluens*	
Smooth	*Marasmius meridionalis* *Physalacria inflata*		(*Tremiscus helvelloides*)		*Craterellus cornucopioides*	
Merulioid	*Arrhenia auriscalpium*			*Boletinellus merulioides*	*Craterellus tubaeformis*	

Hibbett, D. *Mycol. Res.* **111**, 1001–1018 (2007) https://www.sciencedirect.com/science/article/abs/pii/S0953756207000160?via%3Dihub

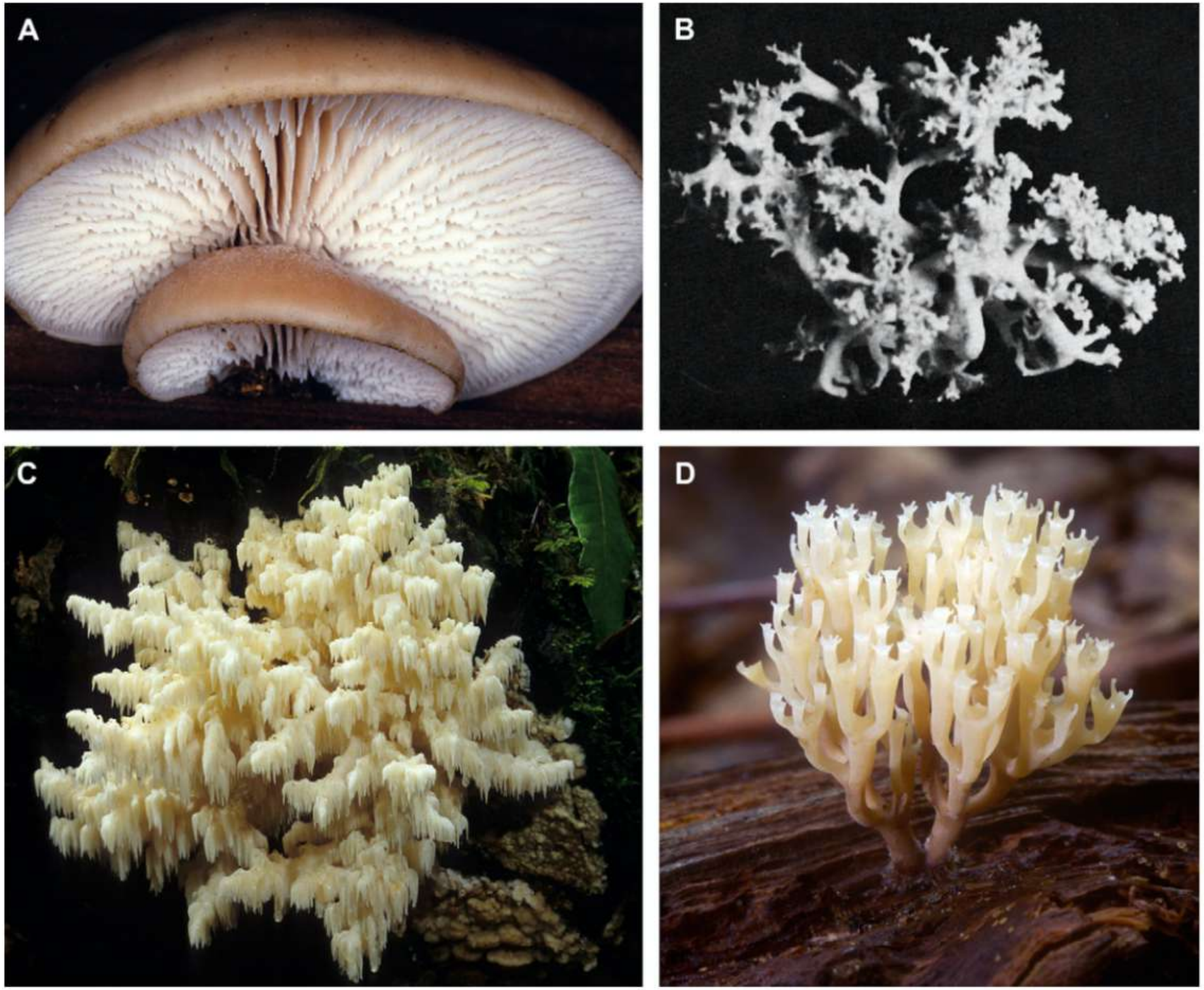
Table 1 – (continued)

	Agaricales	Atheliales	Auriculariales	Boletales	Cantharellales	Corticiales
Smooth	*Cylindrobasidium evolvens*	*Athelia arachnoidea* *Piloderma fallax* *Tylospora asterophora*	*Basidiodendron caesiocinereum* *Eichleriella deglubens* *Exidia glandulosa*	*Coniophora puteana*	*Botryobasidium isabellinum* *Sistotrema sernanderi* *Tulasnella pruinosa*	*Dendrocorticium roseocarneum* *Galzinia incrustans* *(Laetisaria fuciformis)* *Vuilleminia comedens*
Merulioid			*Auricularia mesenterica*	*Pseudomerulius aureus* *Serpula lacrymans*		
Clavarioid	*Typhula phacorhiza*				*Multiclavula mucida*	
Coralloid	*Clavaria zollingeri* *Pterula multifida*				*Clavulina cinerea*	
Cyphelloid	*(Auriculariopsis ampla)* *(Caripia montagnei)* *Cyphella digitalis* *Henningsomyces candidus* *Stigmatolemma poriiforme*					
Gasteroid						
Epigeous	*Crucibulum laeve* *Lycoperdon pyriforme* *(Nia vibrissa)* *Thaxterogaster pingue* *Torrendia pulchella*			*Astraeus hygrometricus* *Calostoma cinnabarinum* *Gastrosuillus laricinus*		
Hypogeous	*Amarrendia gradnispora* *Hydnangium carneum* *Quadrispora oblongispora*			*Alpova trappei* *Melanogaster tuberiformis* *Rhizopogon rubescens*		

Phaeoclavulina myceliosa
Gomphales

Clavulina cinerea
Cantharellales

Macrotyphula juncea
Agaricales

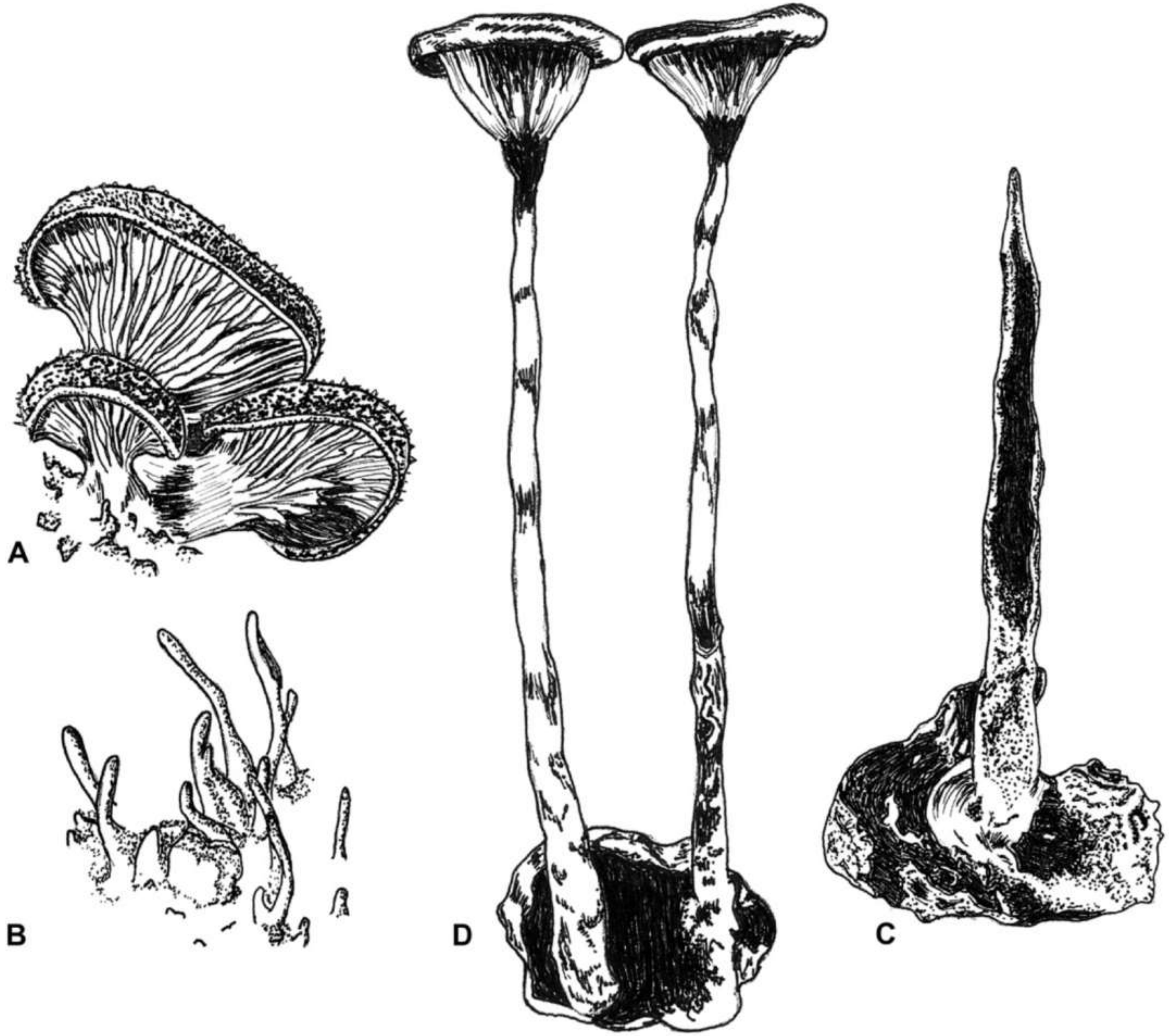


Russulales

Developmental plasticity and evolution in Lentinellus and related Russulales. (A) Lentinellus montanus, typical agaricoid form. (B) L. pilatii, coralloid form produced in culture (Miller 1971, fig 58). (C) Hericium ramosum. (D) Clavicorona pyxidata (syn. Artomyces pyxidata). (A, C–D) images from www.MykoWeb.com a Michael Wood. (B) a Orson K. Miller, jr.

Hibbett, D. *Mycol. Res.* **111**, 1001–1018 (2007)

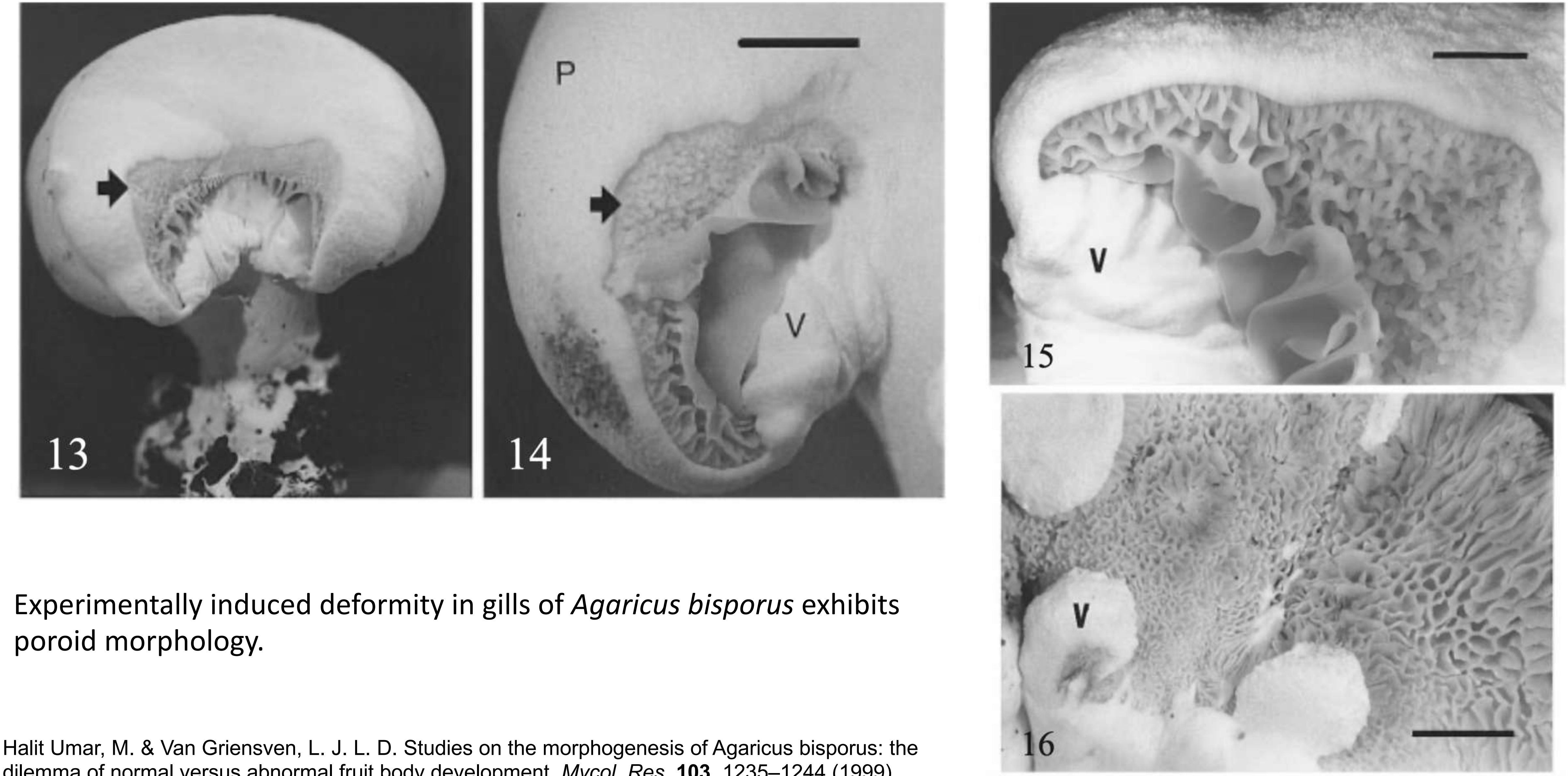
I II III



Signatures of “common programs.”

Developmental plasticity and evolution in Panus s. str. (A) Typical form of Panus rudis (P. lecomtei) with a short, lateral stipe. (B) Developmental variant of P. rudis with elongate primordia produced under low-light conditions, after Miller (1967, fig 3). (C-D) P. fulvus has an elongate stipe and a prolonged primordial phase, after Hibbett et al. (1993a,b, figs 30–31). Drawings by Preethi S. Raj.

Hibbett, D. *Mycol. Res.* **111**, 1001–1018 (2007)

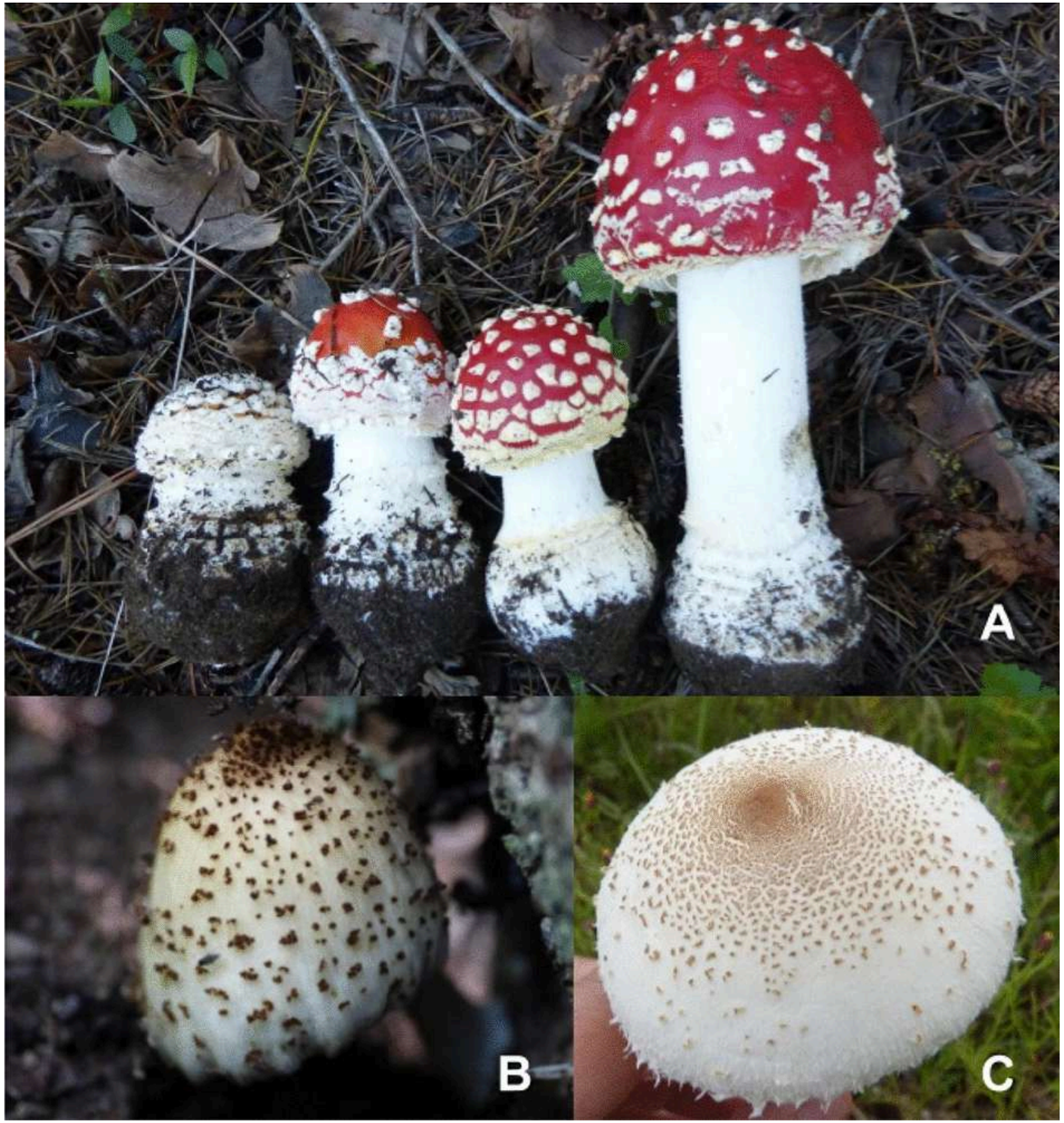


Experimentally induced deformity in gills of *Agaricus bisporus* exhibits poroid morphology.

Halit Umar, M. & Van Griensven, L. J. L. D. Studies on the morphogenesis of Agaricus bisporus: the dilemma of normal versus abnormal fruit body development. *Mycol. Res.* **103**, 1235–1244 (1999)
http://www.wollicreek.org.au/wp-content/wolliupload/Mycological-Res.-1999-v103-p-1235-1244-Rosecomb.pdf

Abnormal specimen of *Amanita phalloides* showing an adventitious pileus growing upside-down on the normal one. The detail shows the irregularly poroid-labyrinthine structure of the hymenophore, atypical for the otherwise lamellar genus. (Images & collection: Alejandro Sequeira)

https://link.springer.com/article/10.1007/s12064-022-00363-z#Fig6



Signs of simple rules.

Patterns of scale distribution resulting from differential growth rates and break-up of hyphal layers of the pilear surface of **A** *Amanita muscaria* (in progressive stages of maturation), **B** *Coprinellus* sp. and **C** *Macrolepiota* sp. (Images & collections: Leticia Terzzoli)

https://link.springer.com/article/10.1007/s12064-022-00363-z#Fig6

I II III

Review | Published: 16 February 2022

Pattern formation features might explain homoplasy: fertile surfaces in higher fungi as an example

Francisco Kuhar, Leticia Terzzoli, Eduardo Nouhra, Gerardo Robledo & Moritz Mercker

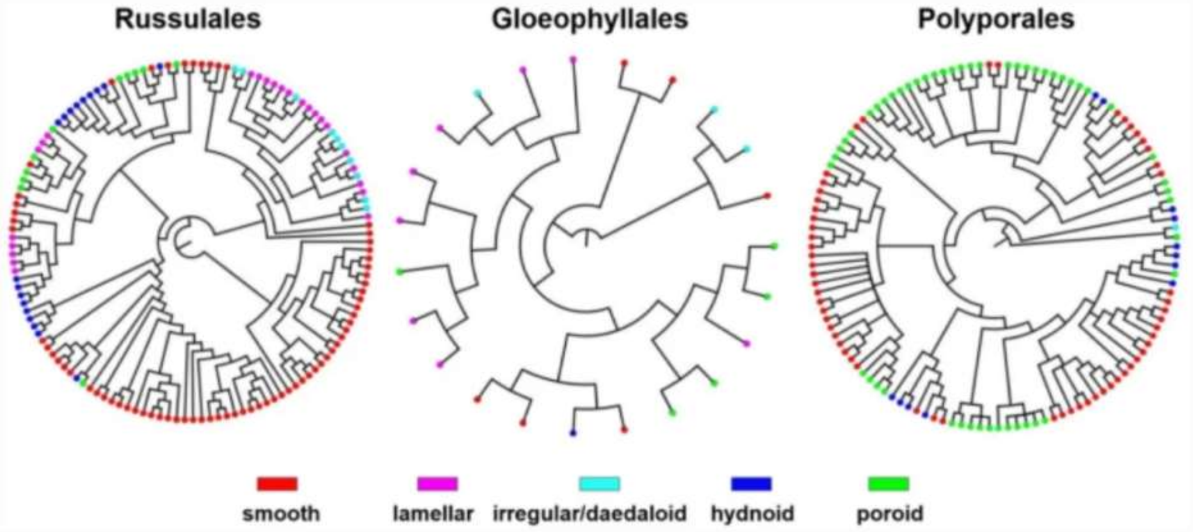
Theory in Biosciences **141**, 1–11 (2022) | Cite this article

Abstract

Fungi show a high degree of morphological convergence. Regarded for a long time as an obstacle for phylogenetic studies, homoplasy has also been proposed as a source of information about underlying morphogenetic patterning mechanisms. The "local-activation and long-range inhibition principle" (LALIP), underlying the famous reaction–diffusion model proposed by Alan Turing in 1952, appears to be one of the universal phenomena that can explain the ontogenetic origin of seriate patterns in living organisms. Reproductive structures of fungi in the class Agaricomycetes show a highly periodic structure resulting in, for example, poroid, odontoid, lamellate or labyrinthic hymenophores. In this paper, we claim that self-organized patterns might underlie the basic ontogenetic processes of these structures. Simulations based on LALIP-driven models and covering a wide range of parameters show an absolute mutual correspondence with the morphospace explored by extant agaricomycetes. This could not only explain geometric particularities but could also account for the limited possibilities displayed by hymenial configurations, thus making homoplasy a direct consequence of the limited morphospace resulting from the proposed patterning dynamics.

https://link.springer.com/article/10.1007/s12064-022-00363-z#Fig6

Fig. 1



modified from Chen et al. 2016), the order Gloeophyllales (modified from Chen et al. 2020) and the phlebioid clade in the order Polyporales (modified from Miettinen et al. 2016)

Distribution of hymenophral patterns in phylogenies of three major Agaricomycetes groups; the order Russulales (

Hymenophoral configurations of agaricomycetes and closely resembling Turing patterns (in black-yellow) as produced using the kernel-simulation software developed by Kondo & Miura (2017). Images: Leticia Terzzoli and Michael Weese

https://link.springer.com/article/10.1007/s12064-022-00363-z#Fig6