Back to Internet Library

Wolf-Ekkehard Lönnig

10 and 21 August 2020 (Minor corrections 22 August 2020)

Plant Galls and Evolution (II):

Natural Selection, DNA, and Intelligent Design

Or: The proof that complex structures of thousands of species have been formed for the exclusive good of other species thus annihilating Darwin's theory

If it could be proved that any part of the structure of any one species had been formed ***for the exclusive good of another species, it would annihilate my theory*** for such could not have been produced through natural selection.

Charles Darwin 1859, p. 201

Galls have not received the attention they deserve. They are often seen as quaint oddities rather than as indicators of interesting happenings in the world of plants and their biotic interactions.

Marion O. Harris and Andrea Pitzschke 2020, p. 1854

Plant galls belong to the widespread biological phenomena "that ***have not been seriously addressed to date*** from an evo-devo perspective. …Plant galls have very seldom been considered as products of developmental processes, something ***they seriously deserve***."
However, the hypothesis that these processes "***are adaptive, as a result of selection, is hard to apply***".

Alessandro Minelli 2018, p. 339 and 2017, p. 102

Even those strongly skeptical about teleological interpretations cannot contest the fact that plant galls are constructions promoting a parasite thus ***benefiting a foreign organism***, devices which already by this support are detrimental to the host plant.

Ernst Küster 1917, p. 567[1]

But how are we to understand the appearance of ***entirely new formations that are completely absent from normal host plants***? How did the plants achieve ***potentials for totally new structures*** [exclusively] ***serving other beings***? [Co-option can explain only a portion of the facts – W.-E. L.] Can the principle of selection help us? No, it fails completely - for how can a selection for altruistic potentials arise?

Otto Braun reviewing book by **Erich Becher 1917, pp. 567/89**[2]

Agamous generation of red-pea gall of gall wasp *Cynips divisa*[3] on oak leaves. Above, from left to right: (1) Photograph of gall wasp *Cynips quercusfolii* (by 'Wofl' in Wikipedia 2020, similar to *C. divisa*), inserted into photo of twig of *Quercus petraea* with leaves and galls seen from above, (2) same viewed from below, (3) leaf with galls enlarged. Below: Side view of the twig with leaves and galls on the underside.

---

[1] Küster: "Dass die Gallen der Pflanzen Gebilde sind, welche der Entwicklung des sie erzeugenden fremden Organismus förderlich sind und schon dadurch, dass sie einen Parasiten der Wirtspflanze fördern, für sie selbst schädlich sind, kann auch von demjenigen, der teleologischen Deutungen gegenüber Skepsis bewahren zu müssen für richtig hält, nicht bestritten werden." (Küster was a critic of teleology.)

[2] Braun: "Wie aber sollen wir das Auftreten ganz neuartiger Bildungen, die den normalen Wirtspflanzen vollständig fehlen, begreifen? (S. 89). Wie sind die Pflanzen zu Potenzen für ganz fremdartige, anderen Wesen dienende Gebilde gelangt? Kann uns das Selektionsprinzip helfen? Nein, es versagt völlig – denn wie soll eine Selektion fremddienlicher Potenzen entstehen?"

[3] Photographs of leaves with galls by W-E L (14 June 2020 in Cologne).

"*For the plant, the entire effort involved in the gall formation is of no apparent benefit, it is more of a harm because it requires nutrients, reduces the assimilating leaf area and disrupts the normal course of growth,* ***sometimes even the most valuable parts of the plants: buds and seeds****. Consequently, according to Darwin, the plants without galls should have an advantage over those with galls, and so in the course of evolution* ***the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones*** [*which obviously is not the case*]." Joachim Illies (a former Director at the Max-Planck-Institute for Limnology, Plön, Außenstelle Schlitz, Professor at the Universities of Gießen and Kiel; acclaimed critic of neo-Darwinism).

Oak leaf with galls (from previous page, first row on the right) further enlarged with different background (flowering Kalanchoe) and sunlight. Photo by W.-E. L. ten days later (24 June 2020)

Contents

Abstract

Several recent DNA/RNA and further molecular studies have corroborated the expectations and predictions made by morphological, anatomical and biochemical research on insect-triggered plant galls during the last some 150 years: These ingenious inter-kingdom complexities, co-adaptations and synorganizations are reflected by correspondingly intricately fine-tuned and exactly (key and lock-like) fitting synorganized structures and systems on the level of molecular genetics.

In the "intimate biochemical interactions" (Body et al. 2019), "hundreds of homologous novel effector proteins" (Stern et al. 2020) generated by the insects can be involved triggering the wide range of "services galls provide" (Harris and Pitzschke 2020), often producing "new organs", or "novel organs", "highly specialized plant organs", "unique organs", "de novo plant tissue or organ", also called "neoformed plant organs", and "ectopic organ[s]" and "entirely new generation of forms"[4], displaying "good, constant, and definite characters" or "true forms as does any independent organic being", in the overwhelming majority characterized also by

[4] For the authors of these formulations, see please the main text.

strict "host specificity" (including the usually strongly different gall forms of insects displaying alternating generations often on distinct plant hosts).

Comparing the respective galls with their surrounding plant tissue, in one example "535 genes are differentially expressed" (Narendran et al. 2020), displaying in another case "no clear similarity, being "dramatically altered" (Hirano et. al. 2020), and in a further instance, of "26,346 grape transcripts expressed in either gall or leaf or both…11,049 were differentially expressed" (Schultz et al. 2019).

Having cited Darwin above with his words "*If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory for such could not have been produced through natural selection*" and Otto Braun and Erich Becher formulating the ensuing basic question for all selection theories – old and modern alike: "*But how are we to understand the appearance of entirely new formations that are completely absent from normal host plants? How did the plants achieve potentials for totally new structures [exclusively] serving other beings? Can the principle of selection help us? No, it fails completely – for how can a selection for altruistic potentials arise*?" And in addition that, "*according to Darwin, the plants without galls should have an advantage over those with galls, and so in the course of evolution the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones*" (Illies), which is denied by the facts, – I have discussed in detail the objections raised by Darwinians and neo-Darwinians against such criticisms in the analysis below.

Result: The evolutionary objections and explanations have been found wanting on all biological levels (*cf*. corresponding chapters): Why the solution proposed by Ernst Mayr and Richard Dawkins has failed: Further evidence / Plant genome potential for gall formation / Extended phenotypes of animals *and* plants / Plant galls: Darwin, Redfern and Straton on natural selection.

In the last chapter the criteria for intelligent Design have been quoted (Explanatory Filter: "Roughly speaking the filter asks three questions and in the following order: (1) Does a law explain it? (2) Does chance explain it? (3) Does design explain it?" "*The Explanatory Filter faithfully represents our ordinary practice of sorting through things we alternately attribute to law, chance, or design*" – "*no magic, no vitalism, no appeal to occult forces*" are involved (Dembski). And, indeed: "Inferring design is widespread, rational, and objectifiable."

Also, among additional points, the criterium of "irreducible complexity" (Michael J. Behe) is briefly mentioned. After enumerating several further tasks and scientific projects for plant gall research, this is my conclusion concerning the question, which of the criteria identifying intelligent design appear to be fulfilled according to our present biological knowledge:

– Vast improbability: fulfilled.
– Specification: fulfilled.
– Purpose: fulfilled.
– Coadaptation/Synorganization: fulfilled (even between kingdoms, "inter-kingdom").
– Irreducibly complexity: most probably fulfilled by many examples.
– Dormant, usually non-appearing form-building abilities [that] can be awakened in the plant: fulfilled.
– Plant 'altruism': fulfilled.
– Insects use complex compositions of proteins for gall induction in coordination with, or attuned to, the potential of gall formation in the affected plants: fulfilled.

Although many research questions are still open, the reader is invited to decide for himself whether he/she can already draw the conclusion to intelligent design for many of the plant gall phenomena.

Preface

In *Part I* of *Plant Galls and Evolution* with the subtitle *How More than Twelve Thousand Ugly Facts are Slaying a Beautiful Hypothesis: Darwinism* the basics of the argument against evolution by natural selection have been presented (see http://www.weloennig.de/PlantGalls.pdf).

Now, the following text provides – apart from some repetitions and a few more general points in the introduction and the following paragraphs – additional insight on certain aspects of the topic as *plant gall complexity*, *plant genome potential for gall formation*, *extended phenotypes for animals* and *plants?* and *plant galls, evolution and intelligent design* considering some more of the "old" and several of the new discoveries of the last three years.

The repetitions are intended to serve a twofold purpose: 1. *Repetitio est mater studiorum* (repetition is the mother of learning) – so it may help to memorize the key points – and 2. It reduces the reader's trouble to regularly jump from one document to the next and back again.

Introduction

As long as human beings have existed on the earth, they must also have perceived plant galls. Just recently[5] a non-scientist lady in her mid-forties wrote me that she had often noted this phenomenon, but "without investigating the matter more thoroughly".

Plants have not only long been noted for these striking features but the galls were also used, for instance, for "the manufacture of permanent inks (such as iron gall ink) and astringent ointments, in dyeing, and in tanning. A high-quality ink has long been made from the Aleppo gall, found on oaks in the Middle East"[6]. Oak galls are rich in resins and tannic acid.

Indeed, oak galls used for ink production had a long tradition.

> "The earliest recipes for oak gall ink come from Pliny the Elder, and are vague at best. Many famous and important manuscripts have been written using ferrous oak gall ink, including the Codex Sinaiticus, [one of] the oldest, most complete Bible currently known to exist, thought to be written in the middle of the fourth century. Due to the ease of making iron gall ink and its quality of permanence and water resistance this ink became the favored one for scribes in the European corridor as well as around the Mediterranean Sea. Surviving manuscripts from the Middle Ages as well as the Renaissance bear this out as the vast majority are written using iron gall ink, the balance being written using lamp black or carbon black inks. Many drawings by Leonardo da Vinci were made with iron gall ink. Laws were enacted in Great Britain and France specifying the content of iron gall ink for all royal and legal records to ensure permanence in this time period as well."[7]

For an in depth investigation on the history of the scientific discovery and utilization of plant galls, see Redfern 2011, mentioning for example that "The Classical Greeks in the fourth century BC knew considerably more about galls and cecidology [the study of plant galls] than did European peoples throughout the next millennium and until the nineteenth century, apart from a few more enlightened pockets of knowledge in the seventeenth century, led by ***John Ray in England*** and ***Marcello Malpighi in Italy***. Malpighi was the first to understand [as far as we know] that galls, although formed of plant tissue, were caused by insects."[8]

Darwin wrote with oak gall ink

As for ***Darwin***, it may be intriguing to note that when he wrote his letters and books on natural selection, he usually used "iron gall ink – consisting of tannin conventionally extracted from oak galls, vitriol, gum, and water, constituting "an ink which was used extensively throughout the nineteenth century"[9].

---

[5] Mail 17 June 2020.
[6] Fine article and overview on plant galls in https://en.wikipedia.org/wiki/Gall (19 June 2020).
[7] https://en.wikipedia.org/wiki/Iron_gall_ink (19 June 2020).
[8] Redfern, Margaret. Plant Galls (Collins New Naturalist Library, Book 117). HarperCollins Publishers. Kindle-Version.
[9] https://www.kew.org/read-and-watch/conserving-darwins-letters

If the main thesis of the present paper as well as its extensive precursor[10] proves to be correct – viz. that galls are "formed for the exclusive good of another species" on the basis of often completely hidden/concealed/invisible "potentials for totally new structures" in the affected plants, thus "annihilating" his theory (see citation above) –, there seems to be something of an irony that his many papers and books on evolution by natural selection were originally written with "oak gall ink" (synonym for "iron gall ink"), inasmuch as Darwin was convinced that the phenomenon of plant galls supported his theory of evolution[11].

Francis Darwin comments on his father's concern, perhaps even enthusiasm, for the topic:

> "His interest in this subject was connected with his ever present wish to learn something of the causes of variation. He imagined to himself wonderful galls caused to appear on the ovaries of plants, and by these means he thought it possible that the seed might be influenced, and thus new varieties arise. He made a considerable number of experiments by injecting various reagents into the tissues of leaves, and with some slight indications of success."

Before these sentences Francis stated:

> "Shortly before his death, my father began to experimentise on the possibility of producing galls artificially. A letter to Sir J. D. Hooker (Nov. 3, 1880) shows the interest which he felt in the question: "I was delighted with Paget's Essay; I hear that he has occasionally attended to this subject from his youth . . . I am very glad he has called attention to galls: this has always seemed to me a profoundly interesting subject; and if I had been younger would take it up.""

In fact, as also mentioned in my paper of 2017, Darwin had a lifelong interest in the topic of plant galls, mentioning them four times in all his editions of the his book *On the Origin of Species*, also several times in *Variation of Plants and Animals under Domestication* (both volumes, both editions 1868, 1875, including a longer paragraph in volume 2), *The Descent of Man*, also both editions 1871, 1874, as well as in his letters to Mr. B. D. Walsh (21 October to 1864 and 27 March 1865) and to Mr. T. Weehan on 9 October 1874.

How many species are involved in gall formation?

How widespread is the phenomenon of plant galls? The numbers given for galled plant species varies between 13% and 45% of the total number of some 422,000 seed plant species, being strongly dependent on the respective ecosystems/regions where the investigations took place (see Table 1 in Espirito-Santo and Fernandes 2007, p. 96[12], see also Fernandes, Lara and Price 1994[13], Carneiro et al. 2014[14], Coelho et al. 2017[15], Costa and Araújo 2019[16]).

Which plants are especially affected? Margaret Redfern:

> "About 98 per cent of known gallers affect flowering plants (angiosperms), with most (90 per cent) on dicotyledons (Meyer, 1987). Galling often affects the commonest and largest plant species more than others. In Europe and North America, about 50 per cent of galls occur on oaks and beeches (Fagaceae), 20 per cent on the daisy family (Asteraceae) and 15 per cent on roses, brambles and cherries etc. (Rosaceae). In South America, Africa and India, galls on legumes (Fabaceae) and acacias (Mimosaceae) predominate. In Australia, more than 50 per cent occur on eucalypts (Myrtaceae)."[17]

But galls also occur on ferns and lycopods (Santos et al. report 2019, p. 53):

> "We recorded 93 host species, belonging to 41 genera. Galls were found in ***20 fern families and one lycophyte family*** (Selaginellaceae). Most galls occur within the more derived ferns of the order Polypodiales, especially the fern families

---

http://darwin-online.org.uk/content/frameset?itemID=CUL-DAR10.2.(1-77)&viewtype=image&pageseq=1
https://en.wikipedia.org/wiki/Iron_gall_ink
https://de.wikipedia.org/wiki/Eisengallustinte Eisengallustinte (oder kurz: Gallustinte) ist eine seit dem 3. Jahrhundert v. Chr. gebräuchliche dokumentenechte schwarze Tinte, die sich gut mit Stahlfedern… schreiben lässt.
"Iron gall ink is primarily made from tannin (most often extracted from galls), vitriol (iron sulfate), gum, and water." https://irongallink.org/igi_indexc752.html and https://irongallink.org/igi_indexee73.html

[10] http://www.weloennig.de/PlantGalls.pdf

[11] See documentation and discussion in http://www.weloennig.de/PlantGalls.pdf pp. 11 and12.

[12] http://labs.icb.ufmg.br/leeb/publicacoes/2007_EspiritoSanto_&_Fernandes.pdf

[13] https://www.nrs.fs.fed.us/pubs/gtr/gtr_nc174.pdf pp. 42-48

[14] https://link.springer.com/chapter/10.1007/978-94-017-8783-3_16

[15] https://repositorio.unesp.br/bitstream/handle/11449/170538/2-s2.0-85040119414.pdf?sequence=1

[16] https://www.researchgate.net/publication/334267908_Distribution_of_gall-inducing_arthropods_in_areas_of_deciduous_seasonal_forest_of_Parque_da_Sapucaia_Montes_Claros_MG_Brazil_effects_of_anthropization_vegetation_structure_and_seasonality

[17] Redfern, Margaret. Plant Galls (Collins New Naturalist Library, Book 117). HarperCollins Publishers. Kindle-Version.
See also Mani 1964 https://link.springer.com/chapter/10.1007/978-94-017-6230-4_1

> Polypodiaceae (21 host species), Dryopteridaceae (14 host species) and Athyriaceae (11 host species). Thirty-eight of the 133 gall morphotypes were induced by mites and 95 by insects of six orders (Coleoptera, Diptera, Hymenoptera, Lepidoptera, Thysanoptera, and Hemiptera). Among the insects, Cecidomyiidae (Diptera) caused most of the galls (35 morphotypes). So far, most galls have been reported from the Neotropical region (40 spp.) and Oriental region (28 spp.)."[18]

Some additional intriguing points may be checked in the volumes of Küster (1911) Redfern (2011), including galls on algae.

The numbers given for insect species triggering plant galls vary strongly. M. M. Espirito-Santo and G. Wilson Fernandes state in their paper *How Many Species of Gall-Inducing Insects Are There on Earth*, and *Where Are They*? (2007, p. 95) that "Estimates of the global richness of gall-inducing insects ranged from 21,000 to 211,000 species, with an average of 132,930 species"[19]. Hearn et al. (2019, p. 1) speak of 30,000 arthropod species[20], and Sahu et al. (2020, p. 1288) mention that "There are approximately 13,000 species of insect gallers known in the world."[21] I myself referred (2017, p. 1) to *More than Twelve Thousand Ugly Facts [which] are Slaying a Beautiful Hypothesis: Darwinism*.[22]

Since "insects cause the majority and induce the greatest variety of structures: gall midges and a few other families of flies (Diptera), gall wasps and sawflies and a few chalcid wasps (Hymenoptera), gall-causing aphids, adelgids, phylloxerans and some psylloids and scale insects (all Hemiptera), and a few beetles (Coleoptera) and moths (Lepidoptera)"[23] we are concentrating in the present article mostly on them.

Plant galls: Definitions

Many definitions have been given for plant galls, often emphasizing different aspects of this multifaceted biological phenomenon – from plant galls as teratological abnormalities to exceptionally elaborate new plant organs "comparable to the specific and often complex shape of organisms capable of reproduction" (emphasis added in all the following brief citations):

> (1) "Galls are structures that form as a result of the ***abnormal growth activities*** of plants in response to gall-inducing organisms. Most galls are caused by nematodes, insects and mites, while a very small percentage are caused by bacteria, fungi and viruses" (Mapes 2008). Insect example: "The galls developed by the plant are a consequence of the reaction of the leaves to the insect bite of the genus *Aploneura*. A ***teratogenic structure*** is produced inside which the insect lives, lays the eggs and the new generation larvae are formed" (Fernandez Oca 2000/2015[24]).

> (2) "Insect galls are highly specialized ***plant organs*** *formed by an* ***intimate biochemical interaction*** *between the plant and a gall-inducing insect*. Galls provide the insect enhanced nutrition and protection against natural enemies and environmental stresses (Body et al. 2019[25]).

> (3) "Galls are modified, invariably symmetrical, ***naturally developing plant structures*** *that arise because of messages from certain specialist insects*, mostly from the Thysanoptera, Hemiptera, Diptera, and Hymenoptera, and in a lesser frequency from the Lepidoptera and Coleoptera." […] "The gall-inducing insects could be termed as ***ecosystem engineers*** in the sense that they manipulate plant architecture to create novel habitats" (Miller and Raman 2019[26]).

> (4) "Gall formation is a remarkable process, in which the ***gall-inducing organism*** *becomes the* ***new organiser of plant development***: normal cellular differentiation is inhibited, and the growth of the tissue

[18] https://pubmed.ncbi.nlm.nih.gov/30561603/
[19] Ann. Entomol. Soc. Am. 100:95-99 (2007): http://labs.icb.ufmg.br/leeb/publicacoes/2007_EspiritoSanto_&_Fernandes.pdf
[20] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6855507/ https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6855507/pdf/pgen.1008398.pdf
[21] http://www.entomoljournal.com/archives/2020/vol8issue2/PartV/8-2-203-718.pdf with references to further authors.
[22] http://www.weloennig.de/PlantGalls.pdf
[23] Redfern, Margaret. Plant Galls (Collins New Naturalist Library, Book 117) . HarperCollins Publishers. Kindle-Version.
[24] https://fdocument.pub/document/etnobotanica-cazorla.html Original Spanish text "Las agallas que desarrolla la planta son consecuencia de la reaccion de las hojas ante la picadura de insectos del genero Aploneura. Se produce una estructura teratogenica en cuyo interior vive el insecto, pone los huevos y se forman las larvas de la nueva generación"
[25] https://www.biorxiv.org/content/10.1101/658823v1.full
[26] https://academic.oup.com/aesa/article-abstract/112/1/1/5123572

is altered to produce characteristic and often bizarre structures" (Ranathunge et al. according to Hartley 2019[27]).

(5) "While consisting of plant tissues, insect induced galls are seen as the ***extended phenotype of the gall inducer*** which might circumvent many or most of the plant defenses" (Fernandez et al. 2008[28]).

(6) "Romanes, in 1889, first suggested that galls evolved *as adaptations of the insect rather than of the host plant*. And, a 100 years later, Dawkins (1982) proposed that plant galls should be regarded as '***the extended phenotype***' *of the galling insect, controlled by the genes of the insect rather than the plant's*" "Some gall wasp galls … actively secrete nectar on to the gall surface (*Dryocosmus cerriphilus* in S. Europe is an example) – ants collect the nectar and protect the gall wasp larva inside from drilling parasitoids. Oak trees do not usually produce nectar, *so the gall wasp and its extended phenotype must have tapped into* ***a developmental pathway that is not normally expressed by the oak***" (Redfern 2011[29]).

(7) "Insect-induced galls ('galls' hereafter) represent highly regulated growth manifestations on plants. They present ***unique geometrical forms***, which are, usually, ***unknown in the normal plant system***. Galls are the best examples for *modified natural structures that arise solely because of messages from an alien organism – the insect*. *Galls develop* ***as an extension of the host-plant phenotype***" (Raman 2011, 2012; see, however, Pan et al. 2015, including Raman). "It is often asserted [mostly by highly qualified entomologists like Weber, Weidner, Eidmann, Kühlhorn, Buhr, Mani, Schremmer and others], that ***galls*** of cynipids on oak ***originated as a means of protection of the hosts*** [i.e. as extended phenotype – not of the galling insect, but of the plant, encapsulating the galling parasite thus preventing further damage]. That is improbable… Galls are not the product of co-evolution, but of a one-sided selection of the cecidogenetic ability of the hymenopterans" (Sedlag 2007[30]).

(8) "A gall is a manifestation of the ***reprogramming*** *of plant cellular growth and/or development …* that begins at the colonization site of a specific foreign organism, which receives specialized services from the plant and continues to interact with the de novo plant tissue or organ as it develops and matures" (Harris and Pitzschke 2020[31]).

(9) "Plant galls represent *a unique and complex* ***inter-specific*** [as well as ***inter-kingdom***] ***interaction*** *between the inducer organism and the host plant*. Insect galls are one such curious wonders of nature that attracts the attention of many naturalists. Galls are […] developed cells that have proliferated in a region of the plant, causing an external swelling or modification of the plant as a result of ***parasitic organism***" (Sahu et al. 2020[32]).

(10) "Any morbid production developed on any part of a plant by an animal ***or vegetable*** parasite ***with active participation of the affected tissue***" (Barthélemy de Nabias 1886[33]). "Galls are defined as modifications of the normal developmental design of plants, produced by a *specific reaction* to the presence and activity of a foreign organism. Although different organisms have the ability to induce galls in plants, ***insect-induced galls are the most elaborate and diverse***" (Gatjens-Boniche 2019[34]). "Cynipid galls: insect-induced modifications of plant development create ***novel plant organs***" (Harper et al. 2004[35]) "The insect induces a differentiation of tissues with features and functions of an ***ectopic organ***, providing nutrition and protection to the galling insect from natural enemies and environmental stresses" (Richardson et al. 2017[36]). "Many galls, especially those involving an insect, have a very specific and often complex shape, ***comparable to the specific and often complex shape of organisms capable of reproduction***. Galls, however, do not reproduce – each individual gall takes origin from a new interaction between the plant and the external agent" (Minelli 2017[37]).

---

[27]https://www.researchgate.net/profile/Hans_Lambers/publication/335337180_Parasitic_plants_galls_and_witches'_brooms/links/5d5f420d92851c3763736607/Parasitic-plants-galls-and-witches-brooms.pdf

[28] https://link.springer.com/article/10.1007/s11829-008-9031-x

[29] https://www.amazon.de/Plant-Galls-Collins-Naturalist-Library/dp/0002201437

[30] https://www.nabu.de/imperia/md/content/nabude/insekten/insecta_10.pdf

[31] https://nph.onlinelibrary.wiley.com/doi/epdf/10.1111/nph.16340

[32] http://www.entomoljournal.com/archives/2020/vol8issue2/PartV/8-2-203-718.pdf

[33]https://books.google.de/books?id=2II6AAAAIAAJ&q=Barth%C3%A9lemy+de+Nabias&dq=Barth%C3%A9lemy+de+Nabias&hl=de&sa=X&ved=2ahUKEwiqkoK5k5rqAhWZwcQBHT9wAYMQ6AEwAHoECAUQAg
Original French text: "Toute production morbide dévelopée sur une partie quelconque d'une plante par une parasite animal ou végétale avec participation active du tissue affecté "

[34] https://scholar.google.de/scholar?as_ylo=2019&q=plant+galls+cynips+cytokinins&hl=de&as_sdt=0,5

[35] https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-3040.2004.01145.x

[36] https://pubmed.ncbi.nlm.nih.gov/26739691/

[37] https://dialnet.unirioja.es/servlet/articulo?codigo=6339852 https://pdfs.semanticscholar.org/df87/8184a93d5496451d905f401e241a554f9662.pdf

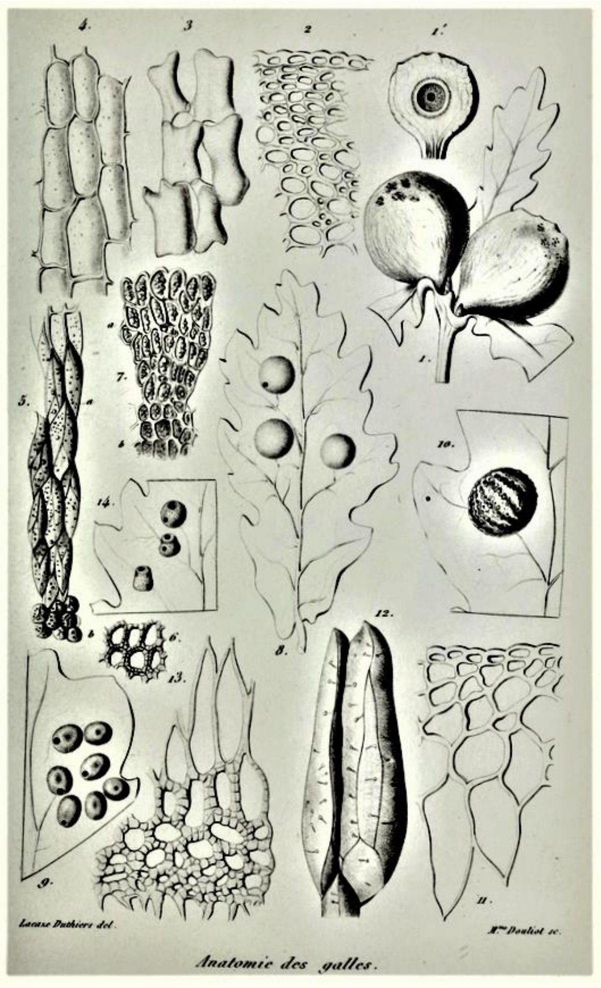
Plant gall complexity

(1) Exact anatomical presentations of some galls by M. Lacaze-Duthier (1853)

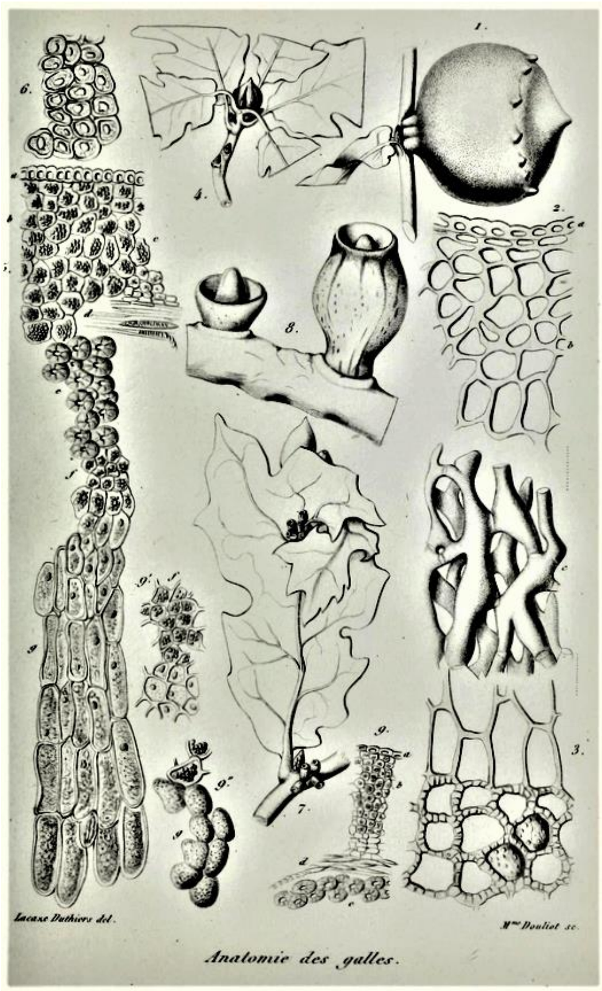
As already mentioned in http://www.weloennig.de/PlantGalls.pdf (2017, p. 9) Darwin [almost] correctly commented on the complexity of plant galls (1875, p. 272) the following points:

> "In some galls the internal structure is simple, but in others it is highly complex; thus M. Lacaze-Duthiers[38] has figured in the ***common ink-gall no less than seven concentric layers***, ***composed of distinct tissue***, namely, the epidermic, sub-epidermic, spongy, intermediate, and the hard protective layer formed of curiously thickened woody cells, and, lastly, the central mass, abounding with starch-granules on which the larvæ feed." [These are six layers; he could have added clearly differentiated layers within layers and the additional vascular bundles: so even more than seven.]

One may study the gall figures (by magnifying the PDF) from the paper by M. Lacaze-Duthiers (1853). At least seven layers in B (Planche17: 5) and C (Planche18: 5 combined with 6)[39]:



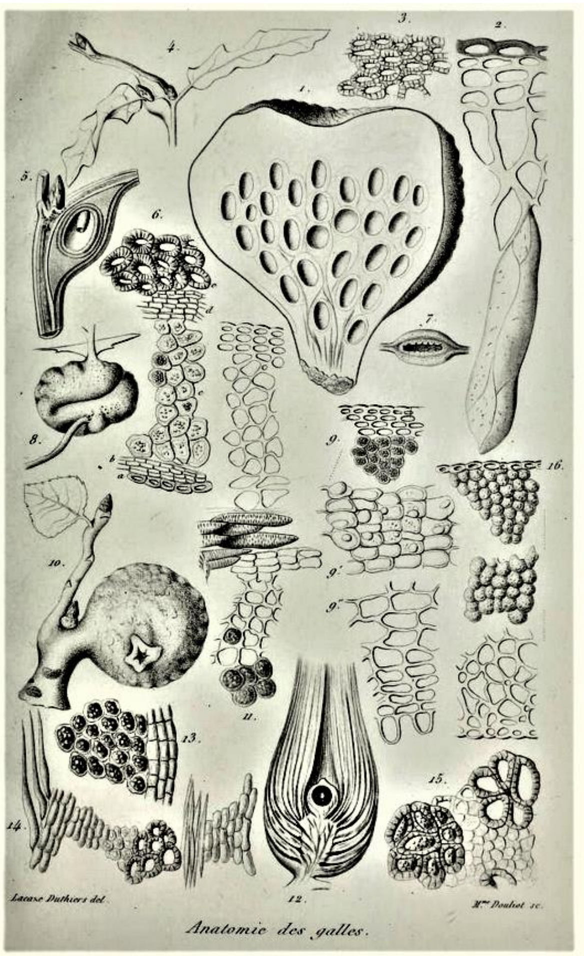
A (Planche 16)



B (Planche 17)

Explanations of the anatomical Details are given on the next page in French (for translation, if necessary, one may use, for example *Google Translator*, or some of the others for comparison; see also as an *addendum* of 28 September 2020 the translation by Huong Imhoff: http://www.weloennig.de/HuongTranslation1853.pdf).

38 https://de.wikipedia.org/wiki/F%C3%A9lix_Joseph_Henri_de_Lacaze-Duthiers
39 https://www.biodiversitylibrary.org/item/129786#page/421/mode/1up



C (Planche 18) D (Planche 19)

M. Lacaze-Duthiers: Legends for the figures[40] (text for Planche 17 enlarged right below):

EXPLICATION DES FIGURES.

(Tous les dessins anatomiques, pris à la chambre claire, sont à 100 de grossissement, *objectif n° 1 de Nachet*.)

PLANCHE 16.

Fig. 1. Noix de Galle du pays.
Fig. 1'. Coupe de la Galle de grandeur naturelle.
Fig. 2. Épiderme et couche sous-épidermique.
Fig. 3. Couche spongieuse.
Fig. 4. Cellules cylindriques faisant le passage de la couche rameuse à la couche dure.
Fig. 5. Couche dure (*a*); couche protectrice (*b*).
Fig. 6. Coupe des cellules protectrices grossies.
Fig. 7. Masse alimentaire : dans la portion (*a*) les grains d'amidon se colorent en bleu par l'iode; dans la portion (*b*) ils ne se colorent pas.

POUR SERVIR A L'HISTOIRE DES GALLES. 353

Fig. 8. Galles dures de la feuille du Chêne, blanches verdâtres, un peu diaphanes, comme de la cire; toujours sphériques; lisses.
Fig. 9. Galles dures des feuilles plus petites que celles du n° 8, un peu aplaties, ovoïdes, brunâtres; lisses.
Fig. 10. Galle dure de la feuille du Chêne, zébrée de rouge-brique obscur et de blanc.
Fig. 11. Épiderme; tissu cellulaire sous-épidermique dans l'espèce n° 1.
Fig. 12. Cellules du parenchyme, dures, épaissies, prismatiques, *id.*
Fig. 13. Couche protectrice, *id.*
Fig. 14. Galles dures de la feuille du Chêne, un peu cylindriques et chagrinées.

PLANCHE 17.

Fig. 1. Galles spongieuses de la feuille du Chêne, venues surtout sur le pyramidal.
Fig. 2. Tissus de la Galle spongieuse de la feuille de Chêne pyramidal : (*a*) épiderme; (*b*) couche sous-épidermique; (*c*) couche spongieuse.
Fig. 3. Couche protectrice.
Fig. 4. Galle du bourgeon terminal du Chêne.
Fig. 5. Coupe de la Galle: (*a*) épiderme; (*b* et *c*) couche sous-épidermique, dont les cellules sont remplies de fécule, présentant cette particularité : en (*b*) les grains sont colorés de vert; en (*c*) ils sont incolores : cela donne à la Galle une apparence de pointillé blanc; (*d*) vaisseaux; (*e*) couche protectrice; (*f*, *g*) couche alimentaire; en (*f*) grains de fécule colorables par l'iode; en (*g*) on n'obtient pas de coloration. Chaque cellule de cette couche renferme un corpuscule brun jaunâtre.
Fig. 6. Épiderme vu de face; chacune des cellules renferme un nucléus arrondi.
Fig. 7. Galle cupuliforme du Chêne.
Fig. 8. Grossie à diverses périodes de son développement.
Fig. 9, 9' et 9''. Coupe de la Galle. Mêmes lettres que pour la figure 5.

PLANCHE 18.

Fig. 1, 2, 3, 4. Quatre espèces de Galles, en parasol, en gimblettes, ou lenticulaires du Chêne.
Fig. 5, 6, 7, 8 et 9. Détails anatomiques de la glande n° 1. 5 (*c*) couche cellulaire sous-épidermique remplie de grains de fécule; parenchyme cellulaire; *e*,*e*, couche protectrice; *g*, couche alimentaire renfermant ici très peu d'amidon; *d*, cellules allongées correspondant aux vaisseaux.
Fig. 6. Épiderme au fond du godet : (*a*) deux couches de cellules épidermiques; (*a'*) cinq couches de cellules aplaties vidées; (*c*) parenchyme.
Fig. 7. Bords du godet; origine des poils.
Fig. 8. *d* et *e*, cellules réticulées grossies à 300 diamètres.
Fig. 9. Figure théorique des Galles en parasol.
3e série. Bot. T. XIX. (Cahier n° 6.) 5 23

354 LACAZE-DUTHIERS. — RECHERCHES, ETC.

Fig. 10. Galles sphériques de la feuille de l'Églantier.
Fig. 11. Épiderme.
Fig. 12. Couches cellulaires, avec quelques grains de feu.
Fig. 13. Bords internes de la couche cellulaire, avec quelques cellules sphéroïdales.
Fig. 14. Bédégar; le commencement de leur développement.
Fig. 15. Détails anatomiques du bédégar.
Fig. 16. Pomme de Chêne coupée longitudinalement.
Fig. 17. Tissus spongieux de cette Galle.

PLANCHE 19.

Fig. 1. Grosse glande des racines du Chêne.
Fig. 2. Tissus épidermique, sous-épidermique, et cellules prismatiques à parois épaisses.
Fig. 3. Couche protectrice limitant les loges.
Fig. 4. Galle interne de la couche cellulaire herbacée des rameaux du Chêne.
Fig. 5. Coupe théorique de cette glande.
Fig. 6. Anatomie : *a*, épiderme; *b*, couche subéreuse; *c*, couche herbacée hypertrophiée; *d*, couche de cellules aplaties, ressemblant à celles de la couche subéreuse; *e*, couche analogue au tissu protecteur des Galles externes.
Fig. 7 et 16. Coupe de la tumeur de la feuille de l'Osier.
Fig. 8. Galle interne du pétiole de la feuille du Peuplier.
Fig. 9, 9', 9''. Tissu de la tumeur, à partir de la surface externe jusqu'à la cavité.
Fig. 10. Tumeur du Peuplier d'Italie.
Fig. 11. Coupe de la tumeur.
Fig. 12. Galles en artichaut du Chêne, coupée longitudinalement.
Fig. 13. Anatomie de la petite tumeur centrale. On remarque des cellules remplies d'amidon, et formant une couche plus épaisse vers la base de la tumeur.
Fig. 14. Anatomie de la base d'une des écailles hypertrophiées du bourgeon.
Fig. 15. Anatomie du col de l'artichaut : on voit des groupes de cellules ponctuées, très épaisses, très grandes, relativement au tissu cellulaire qui les entoure. Ces cellules ressemblent à celles du tissu protecteur.
Fig. 16. Tissu correspondant à la partie supérieure moyenne inférieure de la tumeur de l'Osier.

PLANCHE 17.

Fig. 1. Galles spongieuses de la feuille du Chêne, venues surtout sur le pyramidal.
Fig. 2. Tissus de la Galle spongieuse de la feuille de Chêne pyramidal : (*a*) épiderme; (*b*) couche sous-épidermique; (*c*) couche spongieuse.
Fig. 3. Couche protectrice.
Fig. 4. Galle du bourgeon terminal du Chêne.
Fig. 5. Coupe de la Galle: (*a*) épiderme; (*b* et *c*) couche sous-épidermique, dont les cellules sont remplies de fécule, présentant cette particularité : en (*b*) les grains sont colorés de vert; en (*c*) ils sont incolores : cela donne à la Galle une apparence de pointillé blanc; (*d*) vaisseaux; (*e*) couche protectrice; (*f*, *g*) couche alimentaire; en (*f*) grains de fécule colorables par l'iode; en (*g*) on n'obtient pas de coloration. Chaque cellule de cette couche renferme un corpuscule brun jaunâtre.
Fig. 6. Épiderme vu de face; chacune des cellules renferme un nucléus arrondi.
Fig. 7. Galle cupuliforme du Chêne.
Fig. 8. Grossie à diverses périodes de son développement.
Fig. 9, 9' et 9''. Coupe de la Galle. Mêmes lettres que pour la figure 5.

40 https://www.biodiversitylibrary.org/item/129786#page/358/mode/1up

(2) Genes and DNA sequences
(a) a few examples

As had been anticipated and also been predicted, the complexity of plant gall anatomy finds its counterpart on the molecular level. So, after this brief excursion into the exact anatomical investigations on plant galls in the 19th century, let's now turn to 21st century and look at some discoveries on the DNA level:

First an example of ***535 genes expressed differentially in gall and leaf tissues***:

Narendran et al. (2020): Integrated omics approach to understand *Pistacia* - aphid gall development (pp. 6 and 11)[41]:

> "In the present study, we identified the putative genes (62,801 transcripts) that are specifically expressed in gall (Additional File 3). GA receptor and scarecrow-like protein 8 - DELLA proteins were highly expressed in gall with an FPKM value of 9.28 and 26.97 respectively (Table 4). ***We identified 535 genes that were differentially expressed between gall and leaf tissues*** (Additional File 4). Among these genes coding for biosynthesis of secondary metabolites, plant-aphid interactions, stress responses, phytohormone signal transduction and terpene biosynthesis were [more] highly expressed in gall than in leaf (Table 5).
>
> We had approximately 130 X coverage data for *Pistacia* genome and estimated genome size was 549 Mb. We found a total of 51,290 genes and 231,624 SSRs in *Pistacia* genome. Transcriptome sequencing and de-novo assembly of transcriptome of gall and leaf from *Pistacia* generated 76,186 transcripts from gall and 46,327 from leaf. Transcription factors and enzyme codes in gall and leaf identified from this study. We have identified differentially expressed genes coding for biosynthesis of secondary metabolites, plant-aphid interactions, stress responses, phytohormone signal transduction and terpene biosynthesis that are highly expressed in gall when compared to leaf. Peptide analysis from dry gall of *Pistacia* has identified most abundant aphid peptides such as actin and tubulin. This is the first multiomic study that used to identify differentially expressed genes in gall of *Pistacia*."

Hirano et al. (2020): Reprogramming of the developmental program of *Rhus javanica* during initial stage of gall induction by *Schlechtendalia chinensis*[42]:

> "Although insect galls are fascinating structures for their unique shapes and functions, the process by which gall-inducing insects induce such complex structures is not well understood. Here, we performed RNA-sequencing-based comparative transcriptomic analysis of the early developmental stage of horned gall to elucidate the early gall-inducing process carried out by the aphid, *Schlechtendalia chinensis*, in the Chinese sumac, *Rhus javanica*.
>
> There was **no clear similarity in the global gene expression profiles between the gall tissue and other tissues**, and *the expression profiles of various biological categories such as phytohormone metabolism and signaling, stress-response pathways, secondary metabolic pathways, photosynthetic reaction, and floral organ development* ***were dramatically altered***. Particularly, ***master transcription factors that regulate meristem, flower, and fruit development, and biotic and abiotic stress-responsive genes were highly upregulated, whereas the expression of genes related to photosynthesis strongly decreased in the early stage of the gall developmen***t. In addition, we found that the expression of **class-1 KNOX genes**, whose ectopic overexpression is known to lead to the formation of de novo meristematic structures in leaf, was increased in the early development stage of gall tissue. These results strengthen the hypothesis that gall-inducing insects convert source tissues into fruit-like sink tissues by regulating the gene expression of host plants and demonstrate that such manipulation begins from the initial process of gall induction."

An example of a resistance locus preventing gall formation of the rice gall midge:

P. Leelagud et al. (2020): Genetic diversity of Asian rice gall midge based on mtCOI gene sequences and identification of a novel resistance locus *gm12* in rice cultivar MN62M (p. 4273)[43]:

> "The rice gall midge (RGM), *Orseolia oryzae* (Wood-Mason), is one of the most destructive insect pests of rice, and it causes significant yield losses annually in Asian countries. The development of resistant rice varieties is considered as the most effective and economical approach for maintaining yield stability by controlling RGM. … In this study, a mitochondrial cytochrome oxidase subunit I (mtCOI) was used to analyze the genetic diversity among Thai RGM populations. The phylogenetic tree indicated that the Thai RGM populations were homogeneously distributed throughout the country. The reactions of the resistant rice varieties carrying different resistance genes revealed different RGM biotypes in Thailand. ***The Thai rice landrace MN62M showed resistance to all RGM populations used in this study. We identified a novel genetic locus for resistance to RGM, designated as gm12, on the short arm of rice chromosome 2.*** The locus was identified using linkage analysis in 144 F2 plants derived from a cross between susceptible cultivar KDML105 and RGM-resistant cultivar MN62M with single nucleotide polymorphism (SNP) markers and F2:3 phenotype. The locus was mapped between two flanking markers, S2_76222 and S2_419160. In conclusion, we identified a new RGM resistance gene, gm12, on rice chromosome 2 in the Thai rice landrace MN62M. This finding yielded DNA markers that can be used in MAS to develop cultivars with broad-spectrum resistance to RGM. Moreover, the new resistance gene provides essential information for the identification of RGM biotypes in Thailand and Southeast Asia."

---

[41] https://www.researchgate.net/publication/340194102_Integrated_omics_approach_to_understand_Pistacia_-_aphid_gall_development
[42] https://www.frontiersin.org/articles/10.3389/fpls.2020.00471/full#refer1
[43] https://link.springer.com/article/10.1007/s11033-020-05546-9 History: https://www.ucl.ac.uk/rice/history-rice/debating-origins-rice

Also, wild rice can be infected: "Observations of wild rice in Lao PDR showed that wild rice is infected in the dry season. Seven species of wild and weedy rice have been identified in Lao PDR – *Oryza rufipogon, O. nivara, O. granulate, O. officinalis, O. ridleyi, and O. minuta*…" (see context in Bennet et al. 2004, p. 83[44]).

Let's remember in this context the argument of Professor Joachim Illies of the Max Planck Institute for Limnology on plant galls concerning natural selection and evolution (see above):

> "For the plant, the entire effort involved in the gall formation is of no apparent benefit, it is more of a harm because it requires nutrients, reduces the assimilating leaf area and disrupts the normal course of growth, sometimes even the most valuable parts of the plants: buds and seeds. Consequently, according to Darwin, the plants without galls should have an advantage over those with galls, and so in the course of evolution the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones [which is not the case]."[45]

Several authors suggest that – perhaps somewhat similar to *Agrobacterium tumefaciens* – the transfer and integration of insect genetic material is also involved in the formation of plant galls by insects:

Jankiewicz et al. (2017): Oak leaf galls: *Neuroterus numismalis* and *Cynips quercusfolii*, their structure and ultrastructure (p. 1)[46]:

> "We believe that the deep changes in the morphogenetic program of a leaf, which are caused by the gall-forming insects, are ***impossible without the transfer and the integration of the insect genetic material with that of the host plant***. We also postulate that a larva secrets as yet hypothetical substances, which redirect the nutrients transport from the leaf blade towards the gall and support its vital functions."

However, no verification of the hypothesis so far. Same for the following proposals ("insertion of exogenous genetic elements into the genome of plant gall cells" by an endosymbiotic bacterium):

Omar Gätjens-Boniche (2019): The mechanism of plant gall induction by insects: revealing clues, facts, and consequences in a cross-kingdom complex interaction (p. 1359)[47]:

> "Although different organisms have the ability to induce galls in plants, insect-induced galls are the most elaborate and diverse. Some hypotheses have been proposed to explain the induction mechanism of plant galls by insects. The most general hypothesis suggests that gall formation is triggered by the action of chemical substances secreted by the gall inducer, including plant growth regulators such as auxins, cytokinins, indole-3-acetic acid (IAA), and other types of compounds. However, the mode of action of these chemical substances and the general mechanism by which the insect could control and manipulate plant development and physiology is still not known. Moreover, resulting from the complexity of the induction process and development of insect galls, ***the chemical hypothesis is very unlikely a complete explanation of the mechanism of induction and morphogenesis of these structures***. Considering the finely tuned control of morphogenesis, structural complexity, and biochemical regulation of plant galls induced by insects, it is proposed ***that an induction mechanism mediated by the insertion of exogenous genetic elements into the genome of plant gall cells*** could be involved in the formation of this kind of structure through an endosymbiotic bacterium."

Incidentally, already in 1981 Joachim Illies had proposed the following RNA hypothesis in his paper *Gallenbitteres Ärgernis* (p. 47)[48]:

> "The gall inducers obviously have the ability to crack, tap and manipulate the molecular code of the genetic information that is available in the plant cells. Somehow, they can send their own messenger substances, perhaps specific RNA molecules, into the "hostile" cell and thus take over the command: suppress developmental processes [of the plant], mobilize or redirect others and thus arrange everything in their favor. ... Incidentally, this is also corroborated by the fact that the cell nuclei of the plants near the gall-producing larva are significantly enlarged (up to two hundred times)."

Although at present just working hypotheses, the suggestions reveal at least how deeply impressed these authors are of the complexity of many plant galls ("*deep changes in the morphogenetic program of a leaf*") ("*the chemical hypothesis is very unlikely a complete explanation*"). See also Straka et al. (2010, p. 202): "The formation of galls is ***likely more than just the sum of its chemical constituents*** and the results appear to be subtle, effective, and extremely complex."[49]

---

[44] https://books.google.de/books/about/New_Approaches_to_Gall_Midge_Resistance.html?id=vl65u-nDsBYC&redir_esc=y
[45] Illies, J. (1981, p. 46): Gallenbitteris Ärgernis. Natur – Horst Sterns Umweltmagazin, Juni 1981 Nr 6, p. 46.
[46] http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.agro-9692b730-7e9f-4776-aa02-c54b73f5e103
[47] *Revista de Biología Tropical* 67:1359-1382.
[48] Natur – Horst Sterns Umweltmagazin, Juni 1981: 42-47 (almost verbatim reproduced his book (1991): *Der Jahrhundert-Irrtum. Würdigung und Kritik des Darwinismus.* Umschau Verlag, Frankfurt am Main.
[49] https://www.tandfonline.com/doi/pdf/10.1080/17429145.2010.484552

(b) A closer look at the RNA gall paper by Schultz et al. (2019)

We are now going to cite and review in more detail the largely recommendable[50] *Nature* paper – being a milestone on the molecular genetics of gall research – by Jack C. Schultz et al. *A galling insect activates plant reproductive programs during gall development* (2019, p. 3)[51]:

> "We extracted **RNA** from phylloxera leaf galls on *Vitis riparia* at four intervals as they developed (Fig. 2). Aligning reads to the *Vitis vinifera* genome (Version 12 × ; Phytozome Version 7, Joint Genome Institute) allowed us to identify 26,346 grape transcripts expressed in either gall or leaf or both. Of these, ***11,049 were differentially expressed*** (> 1.5-fold, P < 0.01) at least once in galls compared with ungalled leaves (Fig. 3)."

As for the correct comment of the authors that (p. 1[52]) "many remarkable flower- and fruit-like traits are seen in galls formed by many insect families and orders on many plant species (Fig. 1)" (validated independently also by many authors long before and after Darwin[53] who is mentioned in this context)[54], it would not be uninteresting to have a ratio of the "many insects families and orders" of the ≈132,930 insect species eliciting such "remarkable flower- and fruit-like traits" in galls to those ***primarily*** inducing other traits[55] (could the latter perhaps even be in the majority?) and, moreover, ***how many and which additional RNA transcripts*** are involved in the respective gall formations (pertaining "the hypothesis that insects eliciting complex galls recruit ***portions*** *of the host plant's reproductive program* to produce these necessary characteristics" and "Results confirmed that phylloxera gall development engages ***portions, but not all***, of the floral developmental programs in grapevine" – p. 3) and, above all, ***whether genes, which are never expressed during normal plant development, are also involved***[56].

Furthermore, concerning their *Figure 1* (p. 2) on FLOWER-LIKE and FRUTE-LIKE GALLS, it would have been illuminating to have direct comparisons (photos) with the flowers and fruits of the respective original species to assess and focus not only the remarkable similarities but also the often ***unique and distinctive differences between the galls and the flowers and fruits*** to which they are compared. Also, photos of the insect species could be added on both sides of the figure (seems to have been enough space on both sides of the figure).

Focusing almost exclusively on the similarities could strongly distract the reader's attention from the uniqueness of a plant gall as a ***new morphological and functional entity*** due to non-

---

[50] Recommendable for their painstaking molecular investigations, although several very important aspects and further key points have not been considered by the authors – for example the topic of mutations, selection, "fremddienliche Zweckmäßigkeit", and nothing about chemical signaling, just that it is "poorly understood"

[51] Directly available in https://www.nature.com/articles/s41598-018-38475-6 and https://www.nature.com/articles/s41598-018-38475-6.pdf

[52] Page numbers refer to the PDF document.

[53] Possibly beginning with Theophrast (Θεόφραστος **Theóphrastos c. 371 – c. 287 BC**; for instance the **Mulberry gall** ("Again it has another growth like a mulberry in shape…") and the **hop gall** (***Andricus fecundator***) ("…there is a leaf-like ball, which is oblong and of close texture."), see details and discussion, for example, in Klaus Hellrig & Süleyman Bodur (2015): https://www.zobodat.at/pdf/ForestObserver_007_0121-0182.pdf; original text pp. 199-203 in https://archive.org/details/enquiryintoplant00theo/page/202/mode/2up or some points in Malpighi **1679**; bearbeitet/übersetzt von M. Möbius p. 82 zu "*Crataegus Pyracantha* Pers. (Tafel VII, 11)": "Manche Blätter leiden an fast zahllosen Geschwülsten, die röthlich aussehen und ohne scharfe Grenze über die Ober- und Unterseite des Blattes hervorragen und folgende Form besitzen: ***Sie ähneln einem kleinen Flaschenkürbis***[11]) mit dem Unterschiede, dass sie an der Spitze einige Höcker zeigen; an der entgegengesetzten Seite aber, d. h. auf der Unterseite des Blattes B eine Oeffhung von Anfang an vorhanden ist, umgeben von einem Wulst (7, von dem zahlreiche Haare entspringen: innen ist sie ganz hohl zur Aufnahme der weissen Würmchen." Original 1679, p. 24: "…***Curcubitae medicae speciem aemulantur***…" (perhaps also pp. 28, 36, 42, 44). See also the survey in Chapter 14 by Margaret Redfern 2011.
https://archive.org/details/bub_gb_vrLpTE4ZAQ8C/page/n281/mode/2up?q=galle
https://archive.org/details/bub_gb_vrLpTE4ZAQ8C/page/n365/mode/2up?q=galle
https://ia802706.us.archive.org/8/items/dieanatomiederp00mbgoog/dieanatomiederp00mbgoog.pdf
As for Theophrastos in general, see https://en.wikipedia.org/wiki/Theophrastus

[54] Concerning the statement of Schultz et al. (p. 1): "Darwin also noted the similarity between some galls and fruits in the number, complexity and arrangement of internal tissues. These tissues include a nutritive layer rich in carbohydrates and proteins for the insect much as nucellus or endosperm provide nutrition to plant embryos." Well, first, I would like to point out that he compared it not perhaps with the nucellus or endosperm, but with an entire fruit ("Or compare … ***the fruit of the peach***, with its hairy skin, fleshy covering, hard shell and kernel, and on the other hand one of the more complex galls with its epidermic, spongy, and woody layers, surrounding tissue loaded with starch granules." http://darwin-online.org.uk/converted/pdf/1868_Variation_F877.1.pdf) and, second, it would be interesting to study not only the similarities but also the developmental, anatomical and molecular ***deep dissimilarities/differences*** between the/an (usually triploid) endosperm and the nutritive layers of galls. See perhaps already M. Lacaze-Duthiers (1853) above. Illies wrote (1981, p. 44): Das Staunen wuchs aber, als man die Gallen näher kennenlernte und sah,… dass sie für ihre Untermieter geradezu luxuriös ausgestattet sind. Der innere Hohlraum, in dem die winzigen [Larven] leben, ist mit feinstem und höchst nahrhaftem Gewebe als Schlaraffenland ausgestattet, das von den Insassen nur abgeweidet werden braucht... Fette, Eiweiß und Wasser sind in diesem Nährgewebe reichlich enthalten, konzentriert und mundgerecht ***wie nirgends sonst in der Pflanze"*** (Gallenbitteres Ärgernis; Natur, Juni 1981).

[55] Not easy, for some ***superficial*** similarities with flowers and fruits may almost always be imagined or detected.

[56] Considering, for example, Raman's comment that "the gall [induced by *Phacopteron lentiginosum* on the leaves *Garuga pinnata*], which shoots through the leaf, expresses itself differently on either side of the lamina by differentiating its own epidermises with varying structures: cells at the gall summit are similar to those of the host leaf, whereas those along the mid and lower regions, differentiated through intercalary meristematic activity, vary in their morphologies and ***even generate multicellular trichomes that are absent on normal leaves*** (Raman 1993).)

derivability of entirely new characteristics and their ingenious recombination with "old" ones on all biological levels. Also, it may tend to seduce the reader to assume that the known features explain everything – including the origin and uniqueness of a gall.

Studying the thorough and painstaking investigations of Schultz et al. more closely, considering the large amount of details on the similarities with the genetics of flower formation ("many orthologs of genes that positively regulate flower development were up-regulated" – p. 11), one may eventually ask why a ***unique plant gall and not flower*** is generated by this process. After their doubtful *if not disproved* assertion that "it is important to remember that flowers are modified leaves, evolutionarily" – flowers are, in fact, much more (see Lönnig in *Plant Cell*[57]), it seems that the authors themselves deemed it necessary to state (p.12):

> "**Phylloxera galls are not flowers or fruits**, but their transcriptomes show greater commitment to flowering than do ungalled leaf tissues; **they are neither flowers nor leaves**, but are **unique organs** incorporating traits of both."

Indeed, the galls are neither flowers, fruits nor leaves, but ***unique organs*** – what is missing so far is the molecular basis of their uniqueness. Galls are incorporating traits of all three plant organs and m u c h m o r e. Even Darwin commented in agreement with B. D. Walsh (1868, p. 283 and 1875, p, 273): "Galls, as Mr. Walsh remarks, afford ***good, constant, and definite characters***, each kind keeping as true to form as does any independent organic being."[58]

As zoologist Anne Gauger remarked in a very different context but appliable also here: "*You can have two houses built of the same materials – two by fours, pipes, wall board, nails, wires, plumbing, tile, bricks, and shingles – but end up with very different floor plans and appearances, depending on how they are assembled*."[59]

Casey Luskin on *ID and Systematics* (now expanded for our present topic on plant galls in square brackets; – however, I would like to come back to the topic of design later):

> "Observation: Intelligent agents often re-use functional components in different designs. As Paul Nelson and Jonathan Wells explain: "An intelligent cause may reuse or redeploy ***the same module in different systems*** … [and] generate identical patterns independently" [well shown by Schultz et al 2019 for the generation of plant galls by insects].
> Hypothesis (Prediction): Genes and other functional parts will be commonly re-used in different organisms [and in the cases of plant galls instigated by insects and others ***reused even in the same species and individuals***].
> Experiment: Studies of comparative anatomy and genetics have uncovered similar parts commonly existing in widely different organisms [***and in the cases of plant galls even within the same organisms***]. Examples of "extreme convergent evolution" show re-use of functional genes and structures in a manner not predicted by common ancestry. [Common ancestry did not predict that insects could induce complex new organs in plants – it is just an explanation *post hoc*.]
> Conclusion: The re-use of highly similar and complex parts in widely different organisms [and even by insects ***in the same organisms*** 'for entirely new plant organs (complex, refined, sophisticated, "high tech" galls) consisting of up to seven differentiated layers with diverse positive functions for the guests, ***exclusively built at the expense of the plant host***'], in non-treelike patterns is best explained by the action of an intelligent agent."

Applying some of the points – reuse of the same modules ***and the generation of several unique new features*** and their integration into a new and unique plant organ – in a brief discussion of Figure 1 displayed by Schultz et al. (2019, p. 2) one may ask: *To what extent* is, for example, the gall of *Andricus foecundatrix* (their first photo above on the left) flower-like (bracts, petals, stamens and carpels)? What are the unique morphological features of the gall distinguishing it from the leaves, flowers and fruits as normally generated by oaks?

---

[57] Lönnig. W.-E.: Goethe, Sex and Flower Genes. *Plant Cell* **6**, 574-576 (1994). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC160459/pdf/060574.pdf or http://www.plantcell.org/content/6/5/574 and http://www.weloennig.de/Goeasy.html

[58] http://darwin-online.org.uk/content/frameset?itemID=F878.2&viewtype=text&pageseq=1 and http://darwin-online.org.uk/contents.html

[59] http://www.weloennig.de/KutscheraPortner.pdf, https://evolutionnews.org/2014/03/the_mismeasure/

I myself have tried to illustrate this point as follows – ***add please the materials out of which the examples given consis***t (Lönnig 2012, pp. 219/220: http://www.weloennig.de/Utricularia2011Buch.pdf): "Zu den unterschiedlichen Differenzierungs- und Komplexitätsstufen im Organismenreich generell … vielleicht folgende simple Veranschaulichungen aus der Technik: Beweist die Tatsache, dass es (Kinder-)Roller, kleine und große Fahrräder, Dreiräder, Kinderwagen ('Vierräder'), Motorräder, Autos (PKWs und Lastwagen/Trucks mit mehr als 4 Rädern) etc. gibt, dass sich alles vom Roller ableitet und überdies von selbst entstanden ist (Selbstorganisation)? Und dass etwa bei einem Mercedes 240 E ein funktional irreduzibles *core system* nicht vorhanden wäre? Zeigt uns die Serie Hundehütte, kleine Laube, Lehmhütte, Einfamilienhaus, Villa mit Swimmingpool, Schloss Neuschwanstein, Buckingham Palace, dass sich die Schlösser allesamt von der Hundehütte ableiten und ohne Geist, Plan und Ziel entstanden sind?"

Ernst Küster wrote more than a hundred years ago (1911, p. 95):

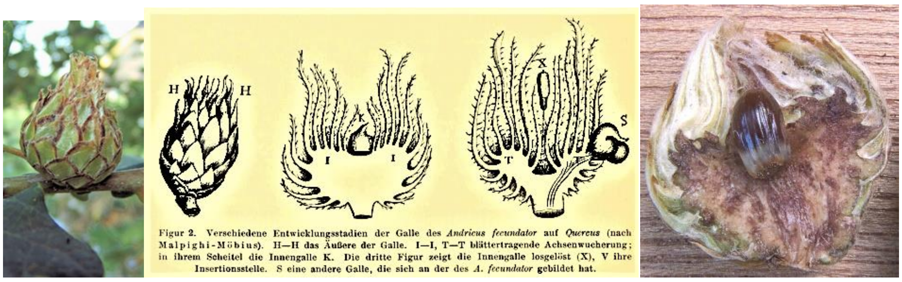
> "The bud galls already described by MALPIGHI, which *Andricus fecundator* [obsolete name for *Andricus foecundatrix*] causes on oaks, the so-called oak artichoke gall [or hop gall] (see Fig. 2), also belong in this context; because the astonishing overproduction of leaves similar to **bud scales**, which give the gall its characteristic appearance – in medium-sized galls there are up to 150 scales – they are probably leaf organs which, ***like the normal bud scales of oak, are to be considered as stipules***."[60]

Heiko Bellmann comments in his book *Geheimnisvolle Pflanzengallen – Ein Bestimmungsbuch für Pflanzen- und Insektenfreunde* concerning *Andricus foecundatrix* (2017, p. 182; similarly H. Bellman, M. Spohn and R. Spohn 2018, p. 288):

> "Gall of the asexual generation (2a) **similar to a hop fruit**, emerging from the tip or side bud of a branch. Numerous round, light green colored and red-brown edged ***bud scales*** envelop an approximately 4 mm long, hard inner gall with the wasp larva inside. When it ripens in September or October, the whole gall opens like a rose flower (2b) and the inner gall falls to the floor. The wasp hatches next spring. The gall is therefore also known as "oak rose gall"."[61]

However, the plant morphologists don't agree with each other. Although no entirely exact developmental and anatomic counterpart is found anywhere on oak trees, the ***bud scales at the base of the catkins*** may phenotypically come closest to the outer part of the gall (the "abnormal giant bud" due to an "overproduction of scales" (Küster 1911, p. 128), also called its organoid part. In contrast, strongly different is the histoid (proximal/inner) part of the same gall, Küster called it "a small hard tissue cone" and Redfern comments 2011 (Kindle version):

> "The artichoke gall develops in a bud during the summer. When full-grown the gall is large, up to 30 x 20 mm, a cluster of enlarged bud scales. ***These enclose an ovoid inner gall***, which replaces the meristem of the bud. The inner gall is 6–9 mm long, shiny brown in colour, and contains the single larva. The larva is full-grown in August."



Left: Gall of *A. fecundatrix* on *Q. robur*[62]. Similar gall picture is shown by Schultz et al. (2019, p.2) as an example of a flower-like gall. Middle: Different developmental stages of the gall of *Andricus fecundator* (= *A. foecundatrix*) according to Ernst Küster 1911, p. 22. Right: Gall opened[63].

(a) Photo of late stage of the gall[64]. (b) Femal flower of *Quercus robur*[65]. (c) Male flower of same species[66]. (d) Detail of *Quercus pedunculata*[67].

---

[60] Küster E. (1911): Die Gallen der Pflanzen – Ein Lehrbuch für Botaniker und Entomologen. Verlag von S. Hirzel, Leipzig. Original German Text: "Die von MALPIGHI bereits beschriebenen Knospengallen, welche *Andricus fecundator* [obsolete name for Andricus foecundatrix] an Eichen hervorruft, die sog. Eichenrosen (vgl. Fig. 2), gehören ebenfalls in diesen Zusammenhang; denn bei der erstaunlichen Überproduktion von knospenschuppenähnlichen Blättern, welche der Galle ihr charakteristisches Aussehen geben – bei mittelgroßen Gallen zählt man bis 150 Schuppen – handelt es sich wahrscheinlich um Blattorgane, welche, ebenso wie die normalen Knospenschuppen der Eiche, als Nebenblätter zu betrachten sind."

[61] Original German text of Bellmann: "Galle der parthenogenetischen Generation (2a) ähnlich einer Hopfenfrucht, aus der Spitzen- oder Seitenknospe eines Zweiges entstanden. Zahlreiche runde, hellgrün gefärbte und rotbraun gerandete Knospenschuppen umhüllen eine etwa 4 mm lange, harte Innengalle mit der darin befindlichen Wespenlarve. Bei der Reife im September oder Oktober öffnet sich die ganze Galle nach Art einer Rosenblüte (2b) und die Innengalle fällt zu Boden. Die Wespe schlüpft im nächsten Frühjahr. Die Galle ist daher auch als „Eichenrosengalle" bekannt.

[62] Clip of photo by Rasbak: https://en.wikipedia.org/wiki/Andricus_foecundatrix.

[63] Clip of photo by Rasbak: https://en.wikipedia.org/wiki/Andricus_foecundatrix

[64]Author: jacilluch: https://commons.wikimedia.org/wiki/File:Agalla_-Andricus_fecundator_(15140018005).jpg

[65] Clip of photo, copyright by Paul Busselen: http://www.blumeninschwaben.de/Hauptgruppen/quercus_stumpf.htm

[66] https://baum-des-tages.blogspot.com/2015/06/eichenbluten.html

[67] According to W. Müller 1885: https://de.wikipedia.org/wiki/Eichen 2020

Now, what about the gall of the sexual generation? "An additional feature of oak cynipid is that a single species may form different galls [as is the case in *Andricus foecundatrix*]. Many species of oak cynipid gall wasp have two generations each year. The galls of the two generations are often ***radically different in structure***…"[68] This seems to be also true for the galls of *Andricus cristallinus*, *A. coronatus*[69] and *A. polycerus* displayed in Figure 1 of Schultz et al. (2019).

> "The sexual gall [of *Andricus foecundatrix*] is small and hairy (Fig. 155); it grows rapidly on a catkin in spring and when full-grown is only 2 mm long" (Redfern 2011, Kindle).

So, is it scientifically valid to assert that "the gall" induced by *Andricus foecundatrix* is similar to a "flower"? Well, it is just the outer/distal part of the compound gall of the asexual generation, which appears to be partially similar ***not*** to a flower, but to the bud scales of oaks, especially those at the base of oak catkins. Even in the final stage of that distal part of the gall's development, delusively often called an "Eichenrosengalle" ("oak-rose gall"), the resemblance can only be called "very superficially". There seems to be no need to further explain that the flowers of roses and oaks are, indeed basically different.

However, as has indeed been shown by Schultz et al. (2019) for an example of plant galls, several basic buildung blocks, RNA sequences (and correspondingly exons of the DNA chains/genes), functional components, identical modules can be re-used for the generation of strongly different biological systems (recall that "phylloxera gall development engages ***portions, but not all***, of the floral developmental programs in grapevine") – just to analogically illustrate: decidedly different buildings as, for instance, nursing homes, hospitals, residents, villas, mansions, castles etc. can all partially be made of the same materials and yet, nobody would confuse the development and architecture of the ***unique buildings*** of the Palace of Versailles with those of Windsor Castle (Berkshire) despite many similarities.

Thus, it is important to note and further to carefully study not only the similarities but also the strong differences of gall formation induced by *Daktulosphaira vitifoliae* or *A. foecundatrix* and probably also of most other examples of "flower-like galls", all of which are ***unique new organs*** due to "a unique and complex inter-specific [as well as inter-kingdom] interaction between the inducer organism and the host plant", being "often complex shape, comparable to the specific and often complex shape of organisms capable of reproduction" (see definitions above).

And let's recall that even Darwin mentioned the "good, constant, and definite characters [of plant galls], each kind keeping as true to form as does any independent organic being" (see above).

In the wake of overemphasis and sometimes even excess of imagined and/or real similarities this uniqueness/individuality/distinctiveness/singularity may not be adequately appreciated anymore or even fully be lost in the minds of the reader, assuming that the similarities enumerated may already explain "everything" (as noted above) – the gall's origin, development and evolution by selection of "mutations with slight or invisible effects on the phenotype" (Mayr) in the sense of neo-Darwinism.

It would be a time-consuming task to critically assess this Figure 1 in detail.

For the time being, let's turn to the much more interesting subtopic of:

---

[68] Cook et al. (1998, p. 262): https://books.google.de/books/about/The_Biology_of_Gall_inducing_Arthropods.html?id=c0lU9HKdsxcC&redir_esc=y

[69] However, only the gall of the asexual generation is known so far. Yet "…the number of *Andricus* species with only an agamous generation is small, or perhaps non-existing" (https://bladmineerders.nl/parasites/animalia/arthropoda/insecta/hymenoptera/apocrita/cynipidae/)

More on natural selection

Let's assume that the present tendency in gall research is absolutely correct suggesting that the entire range of even the most aberrant gall formations in literally thousands of plant species is exclusively due to co-option of plant DNA/RNA-sequences and genes[70] – all necessarily (and without any exception) expressed elsewhere during normal plant development – now being recruited/co-opted by the actions of the gall inducing insects and other species. Thus, in that case, the plants themselves would not actively participate in the process. To emphasize: They would have absolutely nothing "to say", nothing to instruct, nothing to navigate, not anything to preside, not the slightest supervision, not to mention sovereignty, dominion, mastery and reign anywhere in the entire process of gall development and architecture.

In that case the affected plants could analogically perhaps be compared to musical instruments (pianos, violins, guitars etc.) and the insects to the players/musicians, each species playing its individual melody on them. Remains the question, what or who built the instruments and where do the musicians, composers and compositions come from? And how is it possible that such an ***inter-kingdom*** relationship can lead to "very specific and often complex shape, comparable to the specific and often complex shape of organisms capable of reproduction. Galls, however, do not reproduce – each individual gall takes origin from a new interaction between the plant and the external agent" (Minelli 2017 – as quoted above). Fine-tuned inter-kingdom synorganization at its best! Just by an almost endless array of random mutations and selection of – as Darwin used to formulate[71] – "infinitesimally small changes", "infinitesimally slight variations" and "slow degrees" and hence imagined "steps not greater than those separating fine varieties", "insensibly fine steps" and "insensibly fine gradations", "for natural selection can act only by taking advantage of slight successive variations; ***she can never take a leap***, but must advance by the shortest and slowest steps" or "the transition [between species] could, according to my theory, be effected only by numberless small gradations"? (emphasis added). Virtually the same answer is presented by neo-Darwinism today.[72]

Let's apply this theory to plant galls. How often did galls arise independently of each other and – keeping in mind the question of the "infinitesimally small changes" etc. – how many transitional steps would have been necessary in each case?

> "The ability to induce galls has evolved convergently in many taxa, ranging from microbes and fungi to nematodes and arthropods (Meyer 1987). In insects alone, gall induction has evolved in at least the following seven orders: Thysanoptera, Hemiptera, Homoptera, Lepidoptera, Coleoptera, Diptera, and Hymenoptera (Meyer 1987, Dreger-Jauffret & Shorthouse 1992). ***The number of independent origins of gall induction in insects is, however, considerably higher, since within most of these orders there have been several separate lineages leading to the galling habit*** (Dreger-Jauffret & Shorthouse1992, Roskam 1992)."[73]

Considering that the "Estimates of the global richness of gall-inducing insects ranged from 21,000 to 211,000 species, with an average of 132,930" and the lowest number given by some authors was 13,000[74] insects species (see also above). Also, since "…the number of intermediate varieties, which have formerly existed on the earth, [must] be ***truly enormous*** …" as well as "the number of intermediate and transitional links, between all living and extinct species, must have been ***inconceivably great***" (Darwin), the answer to the question of "how

[70] Involved in formation of leaf, flower, fruits, bush, tree.
[71] And as I have repeatedly emphasized in several papers.
[72] See documentation in http://www.weloennig.de/HumanEvolution.pdf
[73] Tommi Nyman (2000, p. 7): https://www.researchgate.net/publication/42425415_Phylogeny_and_Ecological_Evolution_of_Gall-inducing_Sawflies_Hymenoptera_Tenthredinidae
[74] "For gall-inducing insects, a cosmopolitan group of specialist herbivores, **the last, 40-yr-old estimate of global richness indicated 13,000 species**, mostly from temperate regions" Mário M. Espírito-Santo https://www.researchgate.net/publication/232686492_How_Many_Species_of_Gall-Inducing_Insects_Are_There_on_Earth_and_Where_Are_They

often" probably is thousands of times independently with possibly up to inconceivable hundreds of thousands to millions of "intermediate and transitional links" in each case.

This inference would also be in agreement with the fact of host specificity:

> "***Among the known gall-inducing insect taxa, nearly 90% of them have been shown to be specific to their hosts*** (Raman et al. 2005b). Levels of their host fidelity are remarkable compared with those of related, but non-gall-inducing, plant-feeding taxa (Raman 1996). Fidelity of gall-inducing species of North-American Cynipidae (Hymenoptera) to *Quercus* (Fagaceae) demonstrates a high degree of monophagism (Abrahamson et al. 1998); many similar examples from other groups of gall-inducing insects are available (Raman 1996; Gagné 2004; see various chapters in Raman et al. 2005a). This trait is conservatively preserved among gall-inducing insects" (Raman 2012).[75]

How to imagine the Darwin/neo-Darwinian model for each case? Probably like this:

> "Within ordinary leaf-mining insect larvae, an active ingredient (randomly) formed [by "infinitesimally slight variations"] which (accidentally) caused a change in normal growth in the plant [by "insensibly fine steps"] towards a more favorable form for the larva – a swelling, [subsequently then, also in "numberless small gradations an"] abundance of protein, oil droplet storage and water supply – and thus there was a selection advantage for these larvae, which prevailed in the selection. Gradually it went on (by chance), the galls became more and more luxurious, the larvae became fatter and finally only the species of gall insects survived, which as true physiological miracle workers knew how to get the best of homeliness/coziness and nutritiousness from the plants through sophisticated hormone treatment" (Joachim Illies).

The basic improbability of the neo-Darwinian theory also for the generation of insect induced galls has been discussed in my article of 2017 as follows (pp. 21-23) – to recall this key part of the argumentation[76]:

For each of these postulated "insensibly fine steps", each of the "numberless small gradations" etc. the following rule has unanimously been established by population genetics:

> "Even a new mutation that is slightly favorable will usually be lost in the first few generations after it appears in the population, a victim of genetic drift. If a new mutation has a selective advantage of *S* in the heterozygote in which it appears, then the chance is only 2*S* that the mutation will ever succeed in taking over the population. So a mutation that is 1 percent better in fitness than the standard allele in the population will be lost 98 percent of the time by genetic drift."[77]

So, let's keep in mind that for each of the "*extremely slight variations*", each of the "*steps not greater than those separating fine varieties*" a mutation 1 percent better in fitness than the standard allele has to occur at least 50 times (in many cases even much more often[78]) to have a chance to succeed in taking over a population. As for the additional remote possibility of the origin of new genes and protein folds, see, for example, Axe (2017)[79].

Hence, in each and every case of all the different some 132,930 independently arisen galling insects species, correspondingly literally thousands of supposed long evolutionary gall histories must be postulated, all by "*uncountable successive small microevolutionary steps*", "*infinitesimally small inherited variations*" etc. – and each of the necessary mutations had to occur separately of each other at least some 50 times on average to have a chance to succeed in a given population (the regular occurrence of such specific additive gall building mutations simply taken for granted, but so far without any testable evidence).

In other words: for the evolution of complex galls over innumerable intermediary links by the supposed micro-mutations "with slight or even invisible effects on the phenotype" (Mayr) in the genomes of the insects, it has to be assumed that these steps must have been successful not just once, but in each case of the individually evolving galling insect species and corresponding gall phenomena even tens of thousands of times, i.e. for each further infinitesimally small step in millions of years, eventually resulting in the present phenomena of elaborate plant galls.

The situation becomes even more difficult considering the many examples of alternations of generations:

> "The reproduction of the gall wasp is partly pure two-sex propagation, and partly pure parthenogenesis, in which a male is completely unnecessary. With most species, however, an alternation of generations occurs, with one two-sex generation and one parthenogenic generation annually. This process differentiates the various generations primarily in their appearance and the form of the plant galls they induce."

Thus, in all these cases the improbabilities of the sheer endless processes of the selection of mutations with often invisible effects on the phenotype of the insects and the gall devices must at least be doubled, considering the fact that the insects make two usually very distinctive plant galls from one and the same genome – the one two-sex generation and the one parthenogenic generation. So, in spite of all the dissimilarities, the entire superordinate process must also involve tight interconnections on the genetic level but differential gene expression for the two generations that produce the distinct morphology of the respective insect species and especially their different plant galls.

It must be further assumed that, in contrast to the animals, in the plant hosts natural selection not only failed continually and totally to do anything against the parasites – so far no clear signs of resistance – during all the eons of time, but that the plants, in clear opposition and full defiance to natural selection, must increasingly have invested much of their energy and substance to help the parasites flourish, improve and strongly multiply in preparation for the next rounds of infestations.

---

[75] https://www.tandfonline.com/doi/full/10.1080/17429145.2011.630847
[76] http://www.weloennig.de/PlantGalls.pdf
[77] For a discussion including the references, see Lönnig (2016) http://www.weloennig.de/jfterrorchipmunks.pdf
[78] For this important qualification compare the discussion given in the Link just quoted.
[79] D. Axe (2017): Undeniable. How Biology Confirms Our Intuition That Life is designed. HarperOne, San Francisco.

Additionally, all this must be assumed again to be true for all the often strongly different insect (and other) species, which share one and the same plant host. In the case of the oak (*Quercus robur*) 132 (one hundred thirty-two) different galling animals have so far been counted.

And, last not least, imagine for a moment that the host plants are not only "providing nutrition and protection to the galling insect from natural enemies and environmental stresses", generally supposed to be exclusively due to the action of the insect, but actively participate – as a consequence of correspondingly 'altruistic' information in its DNA – in constructing and building the houses for the insect parasites (there are some hints at present that they are, indeed, involved, if perhaps only slightly – a testable hypothesis), then it would have additionally been proved that parts of the structure of any one species had been formed for the exclusive good of another species. For natural selection will never produce in a being anything injurious to itself.

Why the solution proposed by Ernst Mayr and Richard Dawkins has failed: Further evidence

As pointed out in my article of 2017, p. 18 ff. (http://www.weloennig.de/PlantGalls.pdf), the statement of Ernst Mayr "Why ... should a plant make the gall such a perfect domicile for an insect that is its enemy? *Actually, we are dealing here with two selection pressures*" – is a more than doubtful explanation for the origin of insect plant galls. First, it relativizes the postulated "omnipotence"[80] of natural selection in contrast to the neo-Darwinian's belief, best expressed by Darwin himself in the ensuing statement:

> "It may be said that ***natural selection is daily and hourly scrutinizing, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good***; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life."

Correspondingly my comment was (2017, p. 19):

> Natural selection – which was thought to be "daily and hourly scrutinizing, throughout the world, every variation, **even the slightest**; rejecting that which is bad, preserving and adding up all that is good" – not only failed miserably and totally in all the thousands of affected plant host species, but also – against all expectations and predictions – would have been entirely efficacious, successful and victorious exclusively in the ca. 132,930 different galling insect species.

So, it was omnipotent for the insects, but "less omnipotent" for the affected plants – almost something like the "struggle for life" on an abstract higher level – now between the different selection pressures and the fittest one won, as it were. But why should it have been omnipotent only in the case of the insects?

Mayr continued – always with applause and full consent by Richard Dawkins:

> "On the one hand, selection works on a population of gall insects and favors those whose gall-inducing chemicals stimulate the production of galls giving maximum protection to the young larva. This, obviously, ***is a matter of life or death for the gall insect*** and thus constitutes a very high selection pressure."

Ernst Mayr, who indefatigably told us to avoid "typological thinking" and instead to apply and work consistently with "population thinking"[81] now speaks of "a matter of life or death for ***the gall insect***". However, applying population thinking here would mean a population of thousands and millions of insects of a species and not "a matter of life or death for ***the gall insect***"[82], but (if at all) only ***for some individual insects*** (in the imagined beginning of gall evolution by random 'micro'-mutations and the additional "numberless small gradations" improving it further on), which most probably would have no momentous/significant/serious effects for the entire population – so neo-Darwinian evolution would not even have got started that way (not to speak of the improbability of the ensuing long series of fitting random mutations each one at the right place at the right time).

---

[80] See documentation again in http://www.weloennig.de/PlantGalls.pdf and also http://www.weloennig.de/OmnipotentImpotentNaturalSelection.pdf

[81] http://www.weloennig.de/Mayr.html (So even in a letter to me about some botanists, dass man "Arten als Populationen behandeln" muss)

[82] If somebody argues that the expression "the gall insect" already implies a population, he is invited to apply the argument (no momentous/significant/serious effects for the entire population…) directly to it.

Moreover, on *Quercus robur* alone ***"the gall insect"* consists of altogether** ***at least 132 different galling species*** counted so far (*cf. Plant Galls I*, p. 21), in each case 'requiring nutrients, reducing the assimilating leaf area and disrupting the normal course of growth, *often* even of the most valuable parts of the plants: buds and seeds'. For rice (usually just one generation per year) see, for example, above P. Leelagud et al. 2020, and for **herbs** (especially **annuals**) Küster (1911), E. W. Swanton (1912: *British Plant-Galls*); and a series of instances in Bellmann et al. (2018)[83].

Although "one generation per year" seems to be true for most galling insect species (except aphids), there are many which need more time (including several species with alternation of generations/metagenesis). Here are some examples according to Bellman et al. (2018): *Andricus inflator* ("Die Larven verpuppen sich in der Galle am Boden und schlüpfen im folgenden Frühjahr, zum Teil erst ein oder zwei Jahre später" p. 295), *A. quercusramuli* ("Die Larve verpuppt sich in der Galle am Boden. Die Wespe erscheint im nächsten Frühjahr, oft aber auch erst 1-2 Jahre später" p. 307), *A. testaceipes*: wasps leave the gall in the **third year** (p.311), *Callrhytris erythrocephala*: „Die Entwicklung dauert mindestens zwei Jahre" (p. 314). And there are many further such examples. See "annual" and deviations from it in Redfern (2011).

Now, let's assume for a moment that there are indeed different selection pressures for *the insect* ("matter of life or death") and the *host plants* (hardly any or no selective disadvantage in comparison with the non-affected plants at all[84]) as envisioned by Mayr and Dawkins: Why, then, are there – in contrast to the supposed indispensability of the gall for the benefit of the parasite – also ***facultative galls***?

Consider, please, the following statement (*cf. Plant Galls I*: Lönnig 2017, p. 25):

> Already in 1917, p. 567, cecidologist Ernst Küster noted the ensuing facts, ***undeniably falsifying Mayr's statement***:
>
> "For the evaluation of the benefits which the galling animals achieve from the cecidium, and the damage to the host plants arising from the production of the galls, it should also be noted that in the "**facultative galls**" cecidioses are at work, whose cecidiose strength – for still unknown reasons – frequently fails. **Then the formation of the galls does not occur**. **However, the animal is still developing** – a fact which clearly demonstrates that the supposed indispensability of the gall for the benefit of the parasite now appears in a particular light to us."[85]

Moreover, Küster stated in his Textbook (1911, pp. 400/401):

> "I would like to remind you once again of the "facultative" galls, mentioned above (p. 252). They prove to us that cecidozoa and cecidophytes can thrive on their host ***even when gall formation is completely absent***. Cases of this kind should be a reminder to us that the form and structural peculiarities of the gall are not without compelling reasons always and everywhere indispensable conditions for the development of the gall producers; these are most probably not always necessary,…"[86]

So, the inference is unavoidable that – if *the insect* can "thrive on their host even when gall formation is completely absent" – this, obviously, is *not* "a matter of life or death for the gall insect" and thus *definitely does not* "constitute a very high selection pressure" (if any selection pressure at all).

Now, let's assume again for another moment that the story of the different selection pressures is correct: for "*the insect"* ("matter of life or death" – despite "population thinking", according to which neo-Darwinian evolution would not even have got started that way, not to speak of the following necessarily extremely high numbers of "infinitesimally small inherited

---

[83]H. Bellmann, M. Spohn and R. Spohn (2018): Faszinierende Pflanzengallen. Entdecken – Bestimmen – Verstehen. Quelle & Meyer Verlag Wiebelheim.

[84] Or the disadvantage being so slight that "natural selection", which "is daily and hourly scrutinizing, throughout the world, every variation, **even the slightest**; rejecting that which is bad, preserving and adding up all that is good", could not have noticed it – an unbelievable story not only for very heavily infected plants.

[85] E. Küster (1917) Besprechung von Becher, Erich: Die fremddienliche Zweckmäßigkeit der Pflanzengallen und die Hypothes eines überindividuellen Seelischen. https://www.digizeitschriften.de/dms/img/?PID=PPN34557155X_0005%7Clog442

Original German text: "Für die Beurteilung des Nutzens, den die Gallentiere von dem Zezidium haben, und des Schadens, der den Wirtspflanzem aus der Produktion der Gallen erwächst, sei noch nachgetragen, dass bei den „fakultativen Gallen" Zezidiosen am Werke sind, deren zezidiose Kraft nicht selten – aus noch unbekannten Gründen – versagen kann; dann unterbleibt die Gallenbildung. Das Tier aber entwickelt sich dennoch – ein Umstand, der uns die Bedeutung, die vermeintliche Unentbehrlichkeit des mit der Galle für den Parasiten Gebotenen in besonderem Licht erscheinen lässt."

[86] https://archive.org/stream/diegallenderpfla00ks/diegallenderpfla00ks_djvu.txt Original

He continues: "…and the value of the construction details perceptible in the gall for the development of the cecidozoa is in many cases probably a very subordinate factor." Reminds us perhaps somewhat of the carnivorous plant genera *Utricularia, Darlingtonia* and *Heliamphora* inasmuch as (at least) some of their species can survive without having caught anything, and in the case of *Utricularia* sometimes even without forming its ingeniously complex traps (see details in Lönnig 2012, pp. 14, 19, 79-81, 132: http://www.weloennig.de/Utricularia2011Buch.pdf; see also Lönnig 2016, p. 4: https://onlinelibrary.wiley.com/doi/10.1002/9780470015902.a0003818.pub2/figures and 2017 note in http://www.weloennig.de/Utriculariamultifida.pdf). So, in such cases also complex structures are formed without being absolutely necessary for the survival of the populations.

German text of Küster: "Ich möchte hier noch einmal an die „fakultativen" Gallen erinnern, von welchen oben (p. 252) die Rede war. Sie beweisen uns, daß Cecidozoen und Cecidophyten auch dann auf ihrem Wirt gedeihen können, wenn die Gallenbildung ganz ausbleibt. Fälle dieser Art sollen uns eine Mahnung sein, in den Form und Struktureigentümlichkeiten der Gallen nicht ohne zwingende Gründe immer und überall unentbehrliche Voraussetzungen für die Entwicklung der Gallenerzeuger zu finden; jene sind höchstwahrscheinlich keineswegs immer notwendig, und der Wert der an den Gallen wahrnehmbaren Konstruktionseinzelheiten für die Entwicklung der Cecidozoen ist in sehr vielen Fällen wahrscheinlich ein ganz untergeordneter."

variations" – resulting in the accelerated evolution of their galls) in contrast to the *host plants* (showing hardly any or no selective disadvantage in comparison with the non-affected (normal) plants, despite all the loss of nutrients, reduction of the assimilating leaf area, disruption of the normal course of growth, and in often also the loss of even the most valuable parts of the plants: buds and seeds (*cf*. Joachim Illies above)), resulting in a delay of evolution of resistance in the affected plants, regularly lagging strongly behind gall production and being overcome millions of times (the innumerable slight steps) by the insects building their galls worldwide instead of stopping the actions of the parasites – now additionally considering and employing the rationale of several highly qualified authors that evolution has slowed down[87] – why should this imagined past process of different selection pressures also be going on at present as ever before?

There is probably no risk to assume that the attentive reader has already noted the basic *contradictio in adjecto*[88] in the above paragraph.

In each case, the postulated evolutionary process is imagined to have happened over millions of years leading to the present global richness of gall-inducing insects of an average number of 132,930 species.

As just mentioned above, several expert authors argue scientifically that evolution has slowed down. And yet, since thousands of gall-affected plant species still suffer from the loss of nutrients, loss of assimilating leaf area, loss of growth, loss of buds and seeds: "Consequently, according to Darwin [and neo-Darwinism], ***the plants without galls should have an advantage over those with galls***, and so in the course of evolution [past and present] the gall-free variants among the plants should have been chosen [and still should be so] very soon and everywhere as the fittest ones [which obviously is not the case] (see quotation above). – Still no successful selection against gall inducing insects (ca. 132,930 species) by the some 122,380[89] plant species, 98 per cent angiosperms, 90 per cent dicotyledons (see above Espirito-Santo and Fernandes, and Redfern).

Whatever people assume – evolution slowing down or not – on the genetic level there is, as indicated above, the ***enormous improbability of the long series of additively fitting/suitable/right random mutations*** in the insects (the "innumerable slight variations" or "extremely slight variations" as well as "infinitesimally small inherited variations" etc.), each one occurring in their genomes in the necessarily functionally correct sequence at the right chromosomal place

[87] See, for example Besenbacher et al. for humans (2019) https://www.newsweek.com/genetic-mutation-great-apes-humans-chimpanzees-orangutans-gorillas-evolution-1303810 Original article: https://www.nature.com/articles/s41559-018-0778-x / And more general (2017): https://www.wired.com/2017/03/evolution-slower-looks-faster-think/ (2017): https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0183120 ("...stronger selection can imply slower evolution if genetic variation is primarily supplied by recombination. … evolution can slow down even in a mutation-driven situation when a fitness landscape is rugged and population is finite; however, this differs from our result. When selection pressure is too strong, whole population gets stuck into a local maximum of a rugged fitness landscape, and the speed of evolution becomes small."/ Skladnev et al. (2013, p. 255): Complication of Animal Genomes in the Course of the ***Evolution Slowed Down after the Cambrian Explosion***. P.255: "The decreasing absolute rate of animal evolution after the Cambrian explosion is shown to be caused by the decrease in the rate of emergence of the evolving taxons number": in: EVOLUTION Development within Big History, Evolutionary and World-System Paradigms. Edited by Leonid E. Grinin and Andrey V. Korotayev.
https://www.academia.edu/34643901/Evolution_Development_within_Big_History_Evolutionary_and_World-System_Paradigms_2013_
See also: Die Neue Biologie (1990) von Robert Augros (Autor), George Stanciu (Autor). Scherz Verlag München (p. 239: "Dass die Evolution nicht auf ewige Zeiten weitergeht, sondern Beschränkungen unterliegt und am ***Ende sich selbst erschöpft***, folgt auch aus der systematischen Differenzierung.“
Gordon R. Taylor (1983, pp. 80/81): "In contrast with Bernal, Professor C.D**. Darlington**, Sheridan Professor of Botany at Oxford and one time directs of the John Innes Horticultural Institute, considers that ***evolution is slowing down***. He points out that the primitive organisms known as prokaryotes evolved early and then settled down: they do not seem to have changed appreciably in the last billion years. Professor **Grassé** is another who thinks ***evolution is slowing down or even coming to a stop***. So is Professor James **Brough**, Professor of Zoology at Cardiff University. He points out that no new phyla have emerged since the Cambrian age, 500 million years ago. Since then evolution has been restricted to working within about a dozen different patterns. Moreover, the emergence of new classes within phyla had ceased by the Lower Paleozoic, around 400 million years ago. When we descend to the next taxonomic category, the orders, we find that of forty-seven known fossil orders forty had evolved by that time; in the next fifty million years (the Devonian) only three more appeared; and in the next 170 million (the whole Mesozoic) only four, since when none have. There has also been a marked slowing down, Brough holds, in the production of new families. 'As to the future,' he concludes ominously, ***'evolution may go on waking in smaller and smaller fields until it ceases altogether***'" (The Great Evolution Mystery; HarperCollins, New York).

[88] "*Contradictio in adjecto* is Latin for "a contradiction between parts of an argument" (adjectum "brought about, brought forward") - https://en.wikipedia.org/wiki/Contradictio_in_adjecto

[89] Basis: Altogether ca. 422,000 plant species of which 13% to 45% are affected (13%: 54,860 and 45%: 189,000; average 122,380). These are, of course only putative numbers indicating at least the magnitude of the number of galled species affected. Often one plant species is affected by more than one insect species (on oak *Quercus robur* 132 different insect species have been counted (*cf*. http://www.weloennig.de/PlantGalls.pdf p. 22). On the other hand, several insects can induce galls on more than one plant species.

(chromosome fields: Lima de Faria[90]) in the right window of time for coordinated expression on the plant host to build their galls (the "additive typogenesis" of neo-Darwinism).

Back to the topic of **facultative galls**: During the last >100 years many observations, past and present, have strongly reinforced the argument of facultative galls against the idea of Mayr and Dawkins of the "very high selection pressure" for the galling insects in contrast to that of the affected plants.

Some examples: Hermann Ross (1932, p. 219 and *Figure 135*, p. 220): *Praktikum der Gallenkunde*.

> "MOLLIARD (1904, p. 91) reports a remarkable case of malformations of male catkins of the goat willow, *Salix caprea* L. The deformity forms a rounded, about 2.5 cm large ball, and the flowers, especially the stamens, have been changed profoundly. In the middle of the axis is a cavity in which the larva of a weevil, probably *Dorytomus taeniatus* F., lives. It leaves the catkins already in mid-April. The innermost cells bordering the larval chamber grow out callus-like. The gall occurs in some years, but not in others. The reason for this is probably the earlier or later infestation of the catkins by the parasite. MOLLIARD calls such cases "**facultative galls**" (for the original German text see the end of the article).

– These explanations are followed by the corresponding *Figure 135* on page 220.

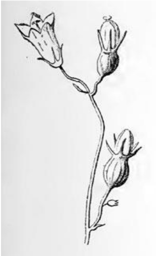
Abb. 135. Mißbildung weiblicher Blütenkätzchen einer Weide, *Salix sp.*, wahrscheinlich ursprünglich verursacht durch den Käfer *Dorytomus taeniatus* F. A Sproß mit drei Mißbildungen am Ende der ersten Vegetationsperiode 1/1. B Schnitt durch eine derartige Mißbildung 2/1; *sp* Sproßachse. C Sproß mit älteren Mißbildungen 1/1. D schwach mißgebildetes Kätzchen zu Anfang des Winters 1/1.

Left. Figure 135 according to Ross (1935, p. 220): Gall formation by probably *Dorytomus taeniatus* (for sure according to Mani 1964).
Right: *Dorytomus taeniatus* according to http://www.naturspaziergang.de/Kaefer/Curculionidae/Dorytomus_taeniatus.htm

M. S. Mani *Ecology of plant galls* (1964, p. 180) also notes this case and adds for the topic of "facultative galls" that of the beetle *Miarus campanulae* L. on the flowers of *Campanula* und *Phyteuma* (*cf.* next page).

See for the host plant species of *Miarus* also (2019):
https://bladmineerders.nl/parasites/animalia/arthropoda/insecta/coleoptera/polyphaga/cucujiformia/curculionoidea/curculionidae/curculioninae/mecinini/miarus/miarus-campanulae/

[90] *Cf.* http://www.weloennig.de/AesIV2.B.6.html http://pdfs.semanticscholar.org/df9e/bbb5807201aef36a8bf54592a790692b38c6.pdf

1 2 3 4

(1) Galls on *Campanula rotundifolia* (see link above). (2) https://de.wikipedia.org/wiki/Rundbl%C3%A4ttrige_Glockenblume (perennial]
(3) https://en.wikipedia.org/wiki/Miarus_campanulae
(4) https://commons.wikimedia.org/wiki/File:Tiny_Bluebell_Weevil_on_bellflower_(9290649823).jpg

2020: About the aphid *Brachycaudus helichrysi*: "…the bright yellow to yellow-green ***facultative gall causer***, known from many host species. *Adenostyles alliariae*[91]: ***Brachycaudus helichrysi***"[92], a "leaf-curling plum aphid".

1 2 3
(1) *Brachycaudus helichrysi* (2) The alate *Brachycaudus helichrysi* (3) Damage on plum
All photographs according to https://influentialpoints.com/Gallery/Brachycaudus_helichrysi_Leaf-curling_plum_aphid.htm
(See all the further details there)

Headrick and Goeden (1998): "Other methods of facultative niche exploitation have been discovered among nonfrugivorous tephritids; some were reviewed by White (126). The flower head–infesting ***Trupanea conjuncta*** is a **facultative gall former** on its nonflowering desert host during drought (23),…" "These tephritids exhibit several different kinds of trophic strategies, including floret/achene/ovule feeding, **facultative gall formation**, alternation of gall-forming and florivorous generations, and stem and crown mining."[93]

Left: Fruit fly *Trupanea crassipes* (*conjuncta* looks similarly; but no clear photo detected so far of the latter): https://ro.wikipedia.org/wiki/Trupanea

Right: *Baccharis salicifolia* "a blooming shrub native to the sage scrub community and desert southwest of the United States and northern Mexico, as well as parts of South America."[94]

---

[91] https://en.wikipedia.org/wiki/Adenostyles (Adenostyles is a genus of flowering plants in the sunflower family Asteraceae, and of the tribe Senecioneae. It was described as a genus in 1816.[1][2] Adenostyles occur in the temperate climates of the northern hemisphere, mainly in Europe and Asia Minor: Brachycaudus helichrysi.

[92] https://bladmineerders.nl/backgrounds/specials/gallers-on-adenostyles/

[93] David H Headrick and R.D. Goeden (1998) The biology of nonfrugivorous tephritid fruit flies Article (PDF Available) in Annual Review of Entomology 43(1):217-41 · February 1998 with 164 Reads DOI: 10.1146/annurev.ento.43.1.217
https://www.researchgate.net/publication/8666022_The_biology_of_nonfrugivorous_tephritid_fruit_flies
https://bladmineerders.nl/parasites/animalia/arthropoda/insecta/hemiptera/sternorrhyncha/aphidoidea/aphididae/aphidinae/macrosiphini/brachycaudus/brachycaudus-helichrysi/

[94] https://en.wikipedia.org/wiki/Baccharis_salicifolia

As for photographs of the facultative galls which *Trupanea conjuncta* can induce, see please below.

Some key points as recorded by Richard D. Goeden (1987, p. 284)[95]:

"Unique among *Trupanea* ssp. and other flower head-infesting Tephritidae as known to date, this species is a **facultative gall former**. ***If flower heads are absent or rare*** *from a lack of local rainfall,* ***gravid females may oviposit in apical buds and the larvae develop to maturity gregariously in the galls so induced***. Thus, another reason for gall formation by insects has been discovered, i.e., as an alternative mode of reproduction and development by a flower-infesting species. Egg resorption also may have evolved as a mechanism for extending the ovipositional period and host-searching capacity of this fly."

And in detail (p. 288):

"***The galls of T. conjuncta are initiated when the female oviposits in a terminal bud***. The round of ovipositional scar was seen on the surface of some galls. Upon hatching, the larvae feed on the surrounding tissues and extend the gall cavity into the pith ***of the branch tip***. If this feeding killed the apical meristem, the branch ceased to elongate and a subspheroidal gall resulted (**Fig. 1b**). If the apical meristems remained intact, the gall assumed a spindle shape as the branch continued apical growth (**Fig. 1e**).

…The larvae fed on the parenchymatous pith tissue, expanding the gall cavity in length and width until, eventually, ***two to five shortened internodes were incorporated in the fully formed galls***. The central cavities of 13 fully formed galls averaged 6.3 ± 0.4 (range: 3.3 to 9) mm in length and 2.6 ± 0.2 (range 1.0 to 3.5) mm in width. The cavities were ellipsoidal (**Fig. 1e**) or subspheroidal (**Fig. 1b**), smooth-walled, and free of frass. none[96], several, or all of ***the axillary buds along the length of the gall***, instead of or as well as ***the terminal bud***, may break dormancy and grow into ***branches***. The vascular cylinder is incorporated in the wall of the gall, which remains green and photosynthetic while the gall remains occupied. ***The fully grown larvae cut one or two short emergence tunnels***, usually laterally in the distal half of the galls, through the 0.75-1.25 mm thick walls, leaving a thin flap of epidermis covering each future exit hole. The larvae usually pupariate with their head directed acropetally towards an exit tunnel. Some larvae pupariated in a partially overlapping linear row and formed only a single, common exit hole. (**Fig. 1e**).

…In a separate paper, I will describe an ***apparent*** example of facultative gall formation in the genus *Tephritis*.

Left below: Figure1 according to R. D. Goeden (p. 286): "Life stages of *Trupanea conjuncta* in **flowerhead** of *Baccharis salicifolia*":

Let's recall, however, that: "*If flower heads are* ***absent*** *or rare* from a lack of local rainfall, gravid females may oviposit ***in apical buds*** and the larvae develop to maturity gregariously in the galls so induced." Now, applying the ***apical buds***[97] of the example of a closely related species of *Trupanea conjuncta,* namely *Tephritis baccharis* (developing a gall also on *B. salicifolia*) on *T. conjuncta* when flower heads are absent, one may perhaps assume that it is inducing a gall in the apical buds ("terminal buds of main and axil1ary branches"?) probably similar to those shown on the right below.[98]

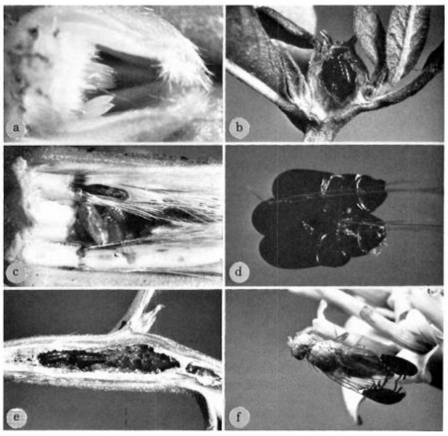
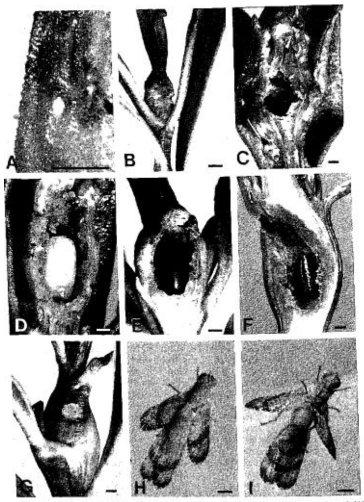


Figure 1. Life stages of *Trupanea conjuncta*. (a) Two egg clusters in young flower head, 16x. (b) Subspheroidal gall containing puparia, 4.3x. (c) Third instars feeding gregariously in flower head, 6.4x. (d) Cluster of empty puparia from flower head, 9x. (e) Ellipsoidal gall containing puparia, 4.3x. (f) Adult female at rest on flower head of *Trixus californica*, 6.6x.



Left: Figure 1according to Goeden (1987): "Life stages of *Trupanea conjuncta* in **flowerhead** of *Baccharis salicifolia*."

Right: Figure 1 from Goeden and Headrick (1991) just to illustrate with *Tephris* (a non-facultative galler) what the different stages of the *Trupeana* facultative gall may look like in case that "flower heads are ***absent*** or rare".

Goeden and Headrick (p. 88): Life stages and galls of *Tephritis baccharis* on *Baccharis salicifolia* (Bar = 1 mm): (A) egg protruding from ovipositional puncture in bud; (B) lateral view of small, immature gall; (C) sagittal section through small immature gall exposing feeding chamber; (D) third instar larva in feeding chamber in full-size gall; (E) gall with apical meristem killed by larval feeding; (F) puparium in feeding chamber below exit tunnel for adult; (G) lateral view of mature gall with round window through which adult emerges; (H) mating adults, dorsal view; (I) mating adults, ventral view.[99]

---

[95] Richard D. Goeden (1987): Life History of *Trupanea conjuncta* (Adams) on *Trixus californica* Kellog in Southern California (Diptera: Tephritida). *Pan-Pacific Entomolgist* **63**: 284-291. See full paper here: https://www.biodiversitylibrary.org/page/56181249#page/294/mode/1up

[96] "(Biology) excrement or other refuse left by insects and insect larvae": https://www.thefreedictionary.com/frass

[97] assuming that the author refers the term not only to flower buds. I have to admit that I have a problem with the application of the terminology of the authors (why give an instance of "Life stages of *Trupanea conjuncta* in flowerhead of *Baccharis salicifoli*a" when the flower heads are absent?. Nevertheless, this does not detract from the fact of this example of facultative galls as a problem for the solution proposed by Mayr and Dawkins.

[98] I could not find an original paper with illustrations in case flowerheads are absent in *Trupanea conjuncta*.

[99] R. D. Goeden and D. H. Headrick (1991): Life history and descriptions of immature stages of *Tephritis baccharis* (Coquillett) on *Baccharis salicifolia* (Ruiz & Pavon) Persoon in Southern California (Diptera: Tephritidae. *Pan-Pacific Entomologist* **67**: 86-98. P. 86: "Eggs are inserted singly into ***terminal buds of main***

Recall in this context that "the flower head-infesting *Trupanea conjuncta* is a facultative gall-former ***on its non-flowering desert host during drought***" (Headrick and Goeden 1998, p.).

Anyway, even if Figure 1 above left represented the only version of the facultative gall of *Trupanea conjuncta* on *Baccharis salicifolia* – it would be a clear example of the fact that the *T. conjuncta* ***populations*** can survive with ***and without*** plant galls and that gall formation is not a "matter of life or death" for "the insect" (***indeed, the overwhelming majority of insect species and beetles – more than 98% – survives splendidly without any gall formation***[100]). Also, since "gravid females may oviposit in apical buds and ***the larvae develop to maturity gregariously in the galls so induced***" the inference already cited above applies to both the insects and the affected plants – just to recall this perhaps most important key point another time:

> "For the ***plant, the entire effort involved in the gall formation is of no apparent benefit***, it is more of a harm because it requires nutrients, reduces the assimilating leaf area and disrupts the normal course of growth, **sometimes even the most valuable parts of the plants: buds and seeds**. Consequently, according to Darwin, **the plants without galls should have an advantage over those with galls**, and so in the course of evolution the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones."

There are many instances of facultative galls. Just another captivating and further examples:

B. Křížková, A. Damaška, J. Hadrava on *Alucita grammodactyla* (Insecta: Lepidoptera: Alucitidae) report in their final report on *Active limestone mining and its positive effect on biodiversity of the quarry and its surroundings* (2012, p. 9):

> "***Larvae of this butterfly from family Alucitidae are facultative gall-inducers***. They are specialists on genus *Scabiosa*. In the quarry, only *Scabiosa ochroleuca* was found. Most of the galls formed by this species were observed directly in the quarry on slowly overgrowing slopes of third floor and not on the steppe. According to *Protection of Nature and Landscape of Prague* (2006) this butterfly is an important indicator of 2nd degree and places of its occurrence should be protected by law."[101]

This what *Alucita grammodactyla* (left)[102] and its facultative gall (right) look like:


Left: Photograph of *Alucita grammodactyla* by Peter Buchner (2014)[103]. Right: Gall by Barbora Křížková (2012)[104].

and axil1ary branches in late winter or early spring. P. 94: "The galls of *T. baccharis*, like those of *T. stigmatica*, are shortened, thickened, ***succulent terminal parts of main or axillary branches*** (Figs. 1D, IE). https://pdfs.semanticscholar.org/281f/3836a795b6368439a68800a24f2b1dec4cd7.pdf

[100] About 132,930 gall inducing species of overall ca. 7,000,000 (= 1.9%) (Including beetles, but mites [small arachnids], nematodes and terrestrial arthropods not included). Nigel A. Stork (2018, p. 31) "In the last decade, new methods of estimating global species richness have been developed and existing ones improved through the use of more appropriate statistical tools and new data. Taking the mean of most of these new estimates indicates that globally there are approximately **1.5 million, 5.5 million, and 7 million species of beetles, insects, and terrestrial arthropods, respectively**. Previous estimates of 30 million species or more based on the host specificity of insects to plants now seem extremely unlikely. **With 1 million insect species named, this suggests that 80% remain to be discovered** and that a greater focus should be placed on less-studied taxa such as many families of Coleoptera, Diptera, and Hymenoptera and on poorly sampled parts of the world." https://www.annualreviews.org/doi/abs/10.1146/annurev-ento-020117-043348 (however, there seem to be different definitions of "terrestrial arthropods", see, for example Batzer and Wu (2020): https://www.annualreviews.org/doi/abs/10.1146/annurev-ento-011019-024902?intcmp=trendmd).

[101] https://www.quarrylifeaward.ru/download-final-report/230/3._place_active_limestone_mining_and_its_positive_effect_on_biodiversity_of_the_quarry_and_its_surroundings.pdf

[102] https://en.wikipedia.org/wiki/Many-plumed_moth: "The Alucitidae or many-plumed moths are a family of moths with unusually modified wings. ***Both fore- and hind-wings consist of about six rigid spines, from which radiate flexible bristles creating a structure similar to a bird's feather***." Incidentally, the anatomy, especially that of the wings – deriving them from ±normal rather flat wings? – appears to be somewhat problematic for a theory of evolution by "infinitesimally small changes", "infinitesimally slight variations", "insensibly fine steps" and "insensibly fine gradations" (postulating that each one of the thousands of successively arising steps and generations would have had decisive selective advantages thus always fully substituting/replacing its hardly different [or even invisibly divergent] previous population – Haldane's dilemma), "for natural selection can act only by taking advantage of slight successive variations; she can never take a leap" (see Darwin and the neo-Darwinians above) – i.e. **problematic quite independently of its facultative gall formation**.

[103] http://www.lepiforum.de/bh/personen/peter_buchner_2/PB_grammodactyla_Alucita_KR5327_2014-08-24_6GUEPL_KMH_4385.jpg

[104] https://www.biolib.cz/en/image/id218687/ Possibly a photograph of the facultative gall of *Alucita grammodactyla* also here: http://www.naturefg.com/pages/g-galls/alucita.htm: "Alucita? (A. huebneri or A. grammodactyla) (on Scabiosa ochroleuca)"

Klaus Hellriegl about Eriophyidae (gall mites) (2003, p. 81):

> "Some inquiline and/or non-inquiline [free living] species can also be ***facultatively cecidogenic*** (see chapter 8.1.)"[105]

Headrick and Goeden (1998) on *Eurosta solidaginis* (goldenrod gall fly/Goldruten-Gallen-Fliege) – PDF without page numeration):

> "*E. solidaginis*, once thought to be an obligate gallicolous species, can infest its host, *Solidago canadensis*, **without forming a gall**, and the non–gall-forming individuals apparently escape most parasitism and predation normally associated with gall-forming larvae (112). ***More of these facultative modes of feeding and alternative developmental strategies will certainly be discovered as more nonfrugivorous tephritids are studied***."[106]

Headrick and Goeden (1991, p. 86) on the nearctic species of *Tephritis* (drilling fly/Bohrfliege):

> "Nearctic species of *Tephritis* are either obligate ***or facultative gall formers on branches or stems, or ovule feeders in capitula*** (Foote 1960; Tauber & Toschi 1965; Jenkins & Turner 1989; Goeden 1988a; RDG, unpublished data)."[107]

W. M. Docters Van Leeuwen (1958, p. 111) on the meadow foam cicada (Wiesenschaumzikade) *Philaenus spumarius*:

> "The galls caused by *Philaenus spumarius* have not been often the subject of investigation. The larvae of the so-called frog-hopper were very numerous in the summer of 1957 and caused deformations on many plants. Those may provide much damage to cultivated plants. ***In a number of plants the larvae cause galls, but they also can live free on the same plant***. In this respect the galls differ from other galls which are indispensable for the development of their inhabitants. Such galls, which develop in some cases while they are absent in others are called **facultative galls** by Molliard."[108]

Jose Luis Nieves Aldrey (1983): *Contribution to the knowledge of the glasshouse thrips Hercinothrips femoralis (O.M. Reuter, 1891) as* ***a facultative gall-former***. *Archiv für Phytopathologie und Pflanzenschutz* **19**: 417-418.

Facultative galls occur even in fungi. According to Alena Nováková et al. – to cite just one rather recent example (2018, p. 111):

> "*Chaetocladium* mainly belong to ***facultative, gall-forming parasites on other Mucorales*** (Benny 2005) and strains of this genus were earlier isolated from marten dung in Ardovská Cave as well as from cave sediment of the Domica Cave (Nováková, unpublished)."[109]

Moreover, there are also facultative gall ***inquilines***[110] and ***occupants***:

Anonymous, posted 16 March 2020: https://p53signals.com/index.php/throughout-2008-galls-were-checked-every-other-month-an/ – Refers to the paper of Maxwell B. Joseph, Melanie Gentles and Ian S. Pearse (2011): *The parasitoid community of Andricus quercuscalifornicus and* ***its association with gall size****, phenology, and location*.[111]

Petr Bogusch et al. (2015, p. 18) in their extensive and detailed article on: *Larvae and Nests of Six Aculeate Hymenoptera (Hymenoptera: Aculeata)* ***Nesting in Reed Galls*** *Induced by Lipara spp. (Diptera: Chloropidae) with a Review of Species Recorded*:

> "Combined data ([2–4] and this study) suggest that the assemblage of aculeate[112] Hymenoptera nesting in reed galls induced by *Lipara* flies comprises in Europe at least 29 species of nesting bees and wasps, 2 cleptoparasites of the genus *Stelis* and 4 parasitic golden wasps bound on their nests, ***including several facultative reed gall inquilines*** newly identified in this study."[113]

---

[105] https://www.zobodat.at/pdf/Gredleriana_003_0077-0142.pdf (Original German text: "Einige inquiline und /oder freilebende Arten können auch **fakultativ cecidogen** sein (vgl. Kap. 8.1)."

[106] file:///C:/Users/ARCHAE~1/AppData/Local/Temp/viewcontent.cgi.pdf

[107] https://pdfs.semanticscholar.org/281f/3836a795b6368439a68800a24f2b1dec4cd7.pdf

[108] https://link.springer.com/article/10.1007/BF01982390 Here you may see what they look like: https://de.wikipedia.org/wiki/Wiesenschaumzikade

[109] http://www.czechmycology.org/_cmo/CM70201.pdf

[110] Inquiline: "an animal exploiting the living space of another, e.g. an insect that lays its eggs in a gall produced by another."

[111] https://www.researchgate.net/publication/226894356_The_parasitoid_community_of_Andricus_quercuscalifornicus_and_its_association_with_gall_size_phenology_and_location

[112] Aculeata is a subclade of Hymenoptera. The name is a reference to the defining feature of the group, which is the modification of the ovipositor into a stinger (thus, the group could be called "stinging wasps", though the group also contains the ants and the bees). In other words, the structure that was originally used to lay eggs is modified instead to deliver venom. Not all members of the group can sting; a great many cannot, either because the ovipositor is modified in a different manner (such as for laying eggs in crevices), or because it is lost altogether. A large part of the clade is parasitic.
This group includes the bees and ants and all of the eusocial Hymenopterans. It is commonly believed that the possession of a venomous sting was one of the important features promoting the evolution of social behavior, as it confers a level of anti-predator defense rarely approached by other invertebrates. https://en.wikipedia.org/wiki/Aculeata

[113] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4482587/ https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4482587/pdf/pone.0130802.pdf

And Bogusch et al. (2016, p. 827):

> "We identified 18 red-listed species and four new species for the Czech Republic (*Gasteruption phragmiticola, Echthrodelphax fairchildii, Haplogonatopus oratorius* and *Enclisis* sp.), representing mostly obligate (64 %) or ***facultative (9 %) reed specialists***."[114]

So, what do all these cases of facultative galls, facultative gall inquilines and facultative occupants[115] reveal us on the assertion of Mayr with full consent by Dawkins that:

> "On the one hand, selection works on a population of gall insects and favors those whose gall-inducing chemicals stimulate the production of galls giving maximum protection to the young larva. This, obviously, ***is a matter of life or death for the gall insect*** and thus constitutes a very high selection pressure."

Hence, apart from the fact that the ***overwhelming majority of insect species*** (not to speak of beetles and mites and others) ***does/do not induce any plant galls at all***[116], and apart from the extreme improbability of the endless generation and successful selection of the postulated perfectly fitting "innumerable slight variations", "extremely slight variations" as well as "infinitesimally small inherited variations" etc. for the neo-Darwinian hypothesis of "additive typogenesis" (Heberer), and – as pointed out above – **if *the galling insect* species can "thrive on their host even when gall formation is completely absent"** (Küster) **– gall evolution obviously is *not* "a matter of life or death for the gall insect**", i.e. *the respective insect populations and species* in relation to their affected plants, and thus *definitely does not* "constitute a very high selection pressure" always victoriously surpassing that of all the often strongly affected ca. 122,380 plant host species[117]. Rather, to repeat and memorize the basic theorem (now slightly changed):

> "For the ***plant, the entire effort involved in the gall formation is of no apparent benefit***, it is more of a harm because it requires nutrients, reduces the assimilating leaf area and disrupts the normal course of growth, **often even the most valuable parts of the plants: buds and seeds**. Consequently, according to Darwin and the modern neo-Darwinians, **the plants without galls should have an advantage over those with galls**, and so in the course of evolution the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones."

This is all the more true since several investigations have shown that resistance to gall formation can involve just one small genetic step on the side of the plants (see example shown by P. Leelagud et al. (2020) cited above, as well as in Lönnig (2017, p. 26):

> So, is the statement of Dawkins really true that the plants 'actually, ***in a sense are acting in their own best interests:***'? Continuing: "…the whole point of the life/dinner principle is that they [the hosts] theoretically could resist manipulation ***but it would be too costly to do so***."
>
> Well, resistance to the sugar beet aphid, for example, was ascribed to both antibiosis and antixenosis "with more recent **evidence that this resistance is conferred *by a single gene***" ("Resistance in some of the varieties tested may be so pronounced that no aphids are able to survive on them") – Pretorius et al. 2016.[118] ***Why have the plants*** – apart from some exceptions usually achieved by human breeding strategies stopping gall formation at the very beginning of its development – ***been able to produce the most astonishing and intricate devices and means to help their parasites grow and flourish but usually nothing to resist them*** (which latter often seems to have been much easier genetically.

Remains to be pointed out that most of the imagined gradual evolutionary processes belong to the category of ***irreproducible results***[119] – nobody can show an insect species starting without any plant gall induction and formation at all (the asserted original evolutionary state of all insect and other populations now capable of gall formations), subsequently followed by the additive production and omnipotent selection of thousands of independently arisen but perfectly fitting mutations with "slight or invisible effects on the phenotype" thus gradually resulting in a

---

[114] https://link.springer.com/article/10.1007/s10531-016-1070-5
[115] This is most probably only a part of the known cases and there is hardly any question than many more such instances will be detected by further research.
[116] This is, of course, also true for the insects of Southern California (referring to the investigations of Goeden and Haedrick and Goeden on *Trupanea conjuncta*. **To survive in Southern California, facultative gall formation during drought is only one option among others**.)
[117] From the neo-Darwinian viewpoint one could also expect that during the very first/initial (hardly well-functioning) phases of especially histoid gall evolution preferentially/mostly facultative structures were produced.
[118] See reference and link above.
[119] See on the principal objection by Theodosius Dobzhansky concerning the irreproducibility of macro-evolution http://www.weloennig.de/HumanEvolution.pdf http://www.weloennig.de/Gesetz_Rekurrente_Variation.html#Aber%20bedenken%20Sie%20doch and http://www.weloennig.de/KutscheraPortner.pdf

complex synorganized plant gall like those investigated and shown above by M. Lacaze-Duthier (1853) and on the molecular level by Schultze et al. (2019), Narendran et al. (2020), and Hirano et al. (2020). – The additional problem of alternations of generations accompanied by often strongly different gall formations not yet mentioned here (see however above).

Plant genome potential for gall formation

The basic question is: How could natural selection produce hidden genetic potentials in plant hosts for entirely new structures serving exclusively their guests?

However: Are there such potentials in the affected plants at all? Well, above we have assumed for the time being that – to repeat:

> – the present tendency in gall research would be absolutely correct suggesting that the entire range of even the most aberrant gall formations in literally thousands of plant species is exclusively due to co-option of plant DNA/RNA-sequences and genes – ***all necessarily (and without any exception) expressed elsewhere during normal plant development*** – now being recruited/co-opted by the actions of the gall inducing insects and other species. Thus, in that case, the plants themselves would not actively participate in the process. To emphasize: They would have absolutely nothing "to say", nothing to instruct, nothing to navigate, not anything to preside, not the slightest supervision, not to mention sovereignty, dominion, mastery and reign anywhere in the entire process of gall development and architecture.

So, was this assumption correct? No!

In the thoroughly peer reviewed and most widely used textbook of botany in the German-speaking countries (Strasburger 37th edition 2014[120]– which is the most recent one at present), we read, among other things, after a few examples of gall formation (p. 478):

> "In the examples mentioned, cell and organ forms are produced under the influence of a foreign organism, ***for which the genetic potential is present in the plant, but which*** [cells and organs] ***are usually not normally formed***. There is no doubt that the various galls come about through the pathogen-specific, spatially and temporally targeted material action of the gall-producing organisms."[121]

In the first part of *Plant Galls and Evolution How More than Twelve Thousand Ugly Facts are Slaying a Beautiful Hypothesis: Darwinism*, I have presented a rather extensive documentation of this phenomenon. From the *Abstract* (p. 3)[122]:

> For the gallers the plants usually provide optimal nutrition (feed and house the larvae), administer excellent microenvironments, enemy escape, produce safe and comfortable homes protecting their hosts (inter alia by phenolic compounds as tannic and gallic acid, displaying antioxidant, anti-bacterial, anti-inflammatory, and anti-fungal properties). In some cases, **the plants even form "a closure similar to that of the ground-glass cap of a liqueur bottle" – to open exactly at the right time and in the optimal form** – so that the parasite can easily press it out when ready for pupation. Also, some investigations have shown that **proteins of inner-gall and plant tissue were "characteristic only for gall tissues**". Moreover, "the **chlorenchyma cells** within the nutritive tissue are generally homogenous and usually include a ***large nucleus, conspicuous nucleolus, high enzymatic activity, RNA richness, fragmented vacuole, numerous mitochondria, a dense/abundant cytoplasm, and the accumulation of carbohydrates (and lipids in some systems***)[123]" (Richardson et al. 2017); for additional special features, see text. As to a synopsis of the present state of the molecular investigations, cf. footnote 171 on p. 59. To sum up: For insects, for example, the plants provide an unsurpassed five-star luxury hotel for free for the entire larval development (and often even more; see please below).

As far as I could find out, all plant gall researchers unanimously agree that in the plant hosts there must be a genetic potential for structures and organs, which are definitely not normally generated.

---

[120] https://www.amazon.de/Strasburger-Lehrbuch-Pflanzenwissenschaften/dp/3642544347

[121] German original text: "In den genannten Beispielen werden demnach unter dem Einfluss eines Fremdorganismus Zell- und Organformen produziert, für die zwar die genetische Potenz in der Pflanze vorhanden ist, die aber normalerweise nicht gebildet werden. Es besteht kein Zweifel, dass die verschiedenen Gallen durch die erregerspezifische, räumlich und zeitlich gezielte stoffliche Einwirkung der gallenerzeugenden Organismen zustande kommen." I would like to add that this **statement** has been **peer reviewed multiple times** by the series of botanical experts responsible for the different editions of that textbook during at least he last **four decades** (see Ziegler in that textbook 1978, p, 422).

[122] http://www.weloennig.de/PlantGalls.pdf

[123] Such chlorenchyma cell may sometimes be similar to others found in the plant host, but they are usually are **not identical** with them – they almost always seem to display their own **gall specific characteristics** in form and function.

As documented in *Plant Galls I*, many authors speak even of "***new organs***" (p. 9). Recall also Harper et al (2004): *Cynipid galls: insect-induced modifications of plant development create* ***novel plant organs***,[124] Body et al. (2019) talk of "***highly specialized plant organs***", Schultz et al. (2019) refer to "***unique organs***", Harris and Pitzschke (2020) to "***de novo plant tissue or organ***", Martini et al. (2020) "***neoformed plant organs***"[125], Minelli (2017) speaks of an "***ectopic organ***" and Strugger already in 1963 of "*völlig neue Formbildungen*", i.e. ***entirely new generation of forms***.

Just some further illustrations of this captivating phenomenon of novel plant organs:

Silk button galls induced by gall wasp *Neuroterus numismalis* occurring on the underside of the leaves of many *Quercus* species. "It has both bisexual and agamic (parthenogenetic) generations and forms two distinct galls on oak leaves, the silk button gall and blister gall. The galls can be very numerous with more than a thousand per leaf"[126] (Photo W.-E. L. 2017).

The imago of the wasp as shown in the excellent documentation of *Plant Parasites of Europe*: https://bladmineerders.nl/parasites/animalia/arthropoda/insecta/hymenoptera/apocrita/cynipidae/neuroterus/neuroterus-numismalis/ (there also photos of the blister galls and of the pupa of the wasp).

[124] https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-3040.2004.01145.x
[125] https://www.researchgate.net/publication/341521242_Photochemical_performance_and_source-sink_relationships_in_galls_induced_by_Pseudophacopteron_longicaudatum_Hemiptera_on_leaves_of_Aspidosperma_tomentosum_Apocynaceae (p.872)
[126] https://fr.wikipedia.org/wiki/Neuroterus_numismalis

Gall of parthenogenetic generation of *Neuroterus quercusbaccarum* (spangle gall) on underside of *Quercus petraea* leaf. 7 October 2018. Photo W.-E. L.

Gall of *Aceria cephalonea* (mite) on *Acer campeste*; below enlarged (25 July 2020. Photo W.-E. L.)

Above: Different aspects of gall of the parthenogenetic generation of *Andricus quercuscialis* on *Quercus petraea*
Photographs by W.-E. L. 27 July 2020

Asexual generation of red-pea gall of gall wasp *Cynips divisa* on underside of oak leaves
(sunshine from above). Photograph by W.-E. L. 26 June 2020.

Left: 14 Nov 2020 (a correction): According to a gall specialist "the larva is likely parasitized by an ichneumon wasp, which means that the gall cannot develop normally". Right: Asexual generation of gall wasp *Cynips divisa*: red-pea gall (both on underside of oak leaf). Photograph by W.-E. L. 26 June 2020.

Professor Joachim Illies, a former director at the Max Planck Institute for Limnology, has lively illustrated the Darwinian problem involved in the fact that by the plant host – to emphasize the formulation of Strasburger's Textbook again (2014): "… cell and organ forms are produced under the influence of a foreign organism, ***for which the genetic potential is present in the plant***, ***but which*** [cells and organs] ***are usually not normally formed***" as follows:

> "…Roots sprout in thick clumps high up from the stem of a grass (Älchengallen/nematode galls), the spruce shoots start the growth of steps from five to six years in advance (witches' brooms), and galls still go on growing even on withered leaves (in the lentil gall of oak) after they have detached from the leaf and have fallen to the ground. And - greatest of all impositions on the critical mind! - The round gall capsules of the South American anacardia *Duvalia* finally form the loopholes for their subtenants (the larva of the moth *Cecidosis eremita*), the lids of which loosen in time and thus free the way for the larvae, which it would not be able to clear on its own!
>
> ... This genetic manipulation goes so far that the host plant surpasses itself [über sich selbst hinauswächst], so to speak. For (the host plant) sometimes forms **organs as in the case mentioned with the lid gall, which otherwise do not occur at all**. Friedrich Schremmer [a neo-Darwinian zoologist] describes this state of affairs as follows: "... **dormant, usually non-appearing form-building abilities can be awakened in the plant**."”[127]

So, what is the problem for contemporary/modern neo-Darwinism? The author continues:

> "Should there be "slumbering" abilities in the genetic code of living things that could never prove their advantage in the selection process, but simply be carried along by thousands of generations as a precautionary measure, until someone comes along like a Sleeping Beauty Prince and kisses them awake? And what coincidence [Zufall] should all such skills have provided?"

Followed by the key point of his analysis:

> "It remains that the galls are a bitter annoyance for Darwinism. Because even if you can understand today how it comes to their formation - through a hormone cocktail that the gall inducers cunningly and knowledgeably administers - ***you are still completely unable to explain the development of such abilities in plants and insects according the model of mutation and selection***. An

[127] For the German original text, see again http://www.weloennig.de/PlantGalls.pdf especially pp. 53/54

explanation would have to start quite differently, completely free from the Darwinian self-interest thinking of the selection/egotism and take a courageous step in another direction."

Now, recall please, that as Narendran et al. report (2020) (see full quotations and plant-insect context above):

> "***We identified 535 genes that were differentially expressed between gall and leaf tissues*** (Additional File 4). Among these genes coding for biosynthesis of secondary metabolites, plant-aphid interactions, stress responses, phytohormone signal transduction and terpene biosynthesis were [more] highly expressed in gall than in leaf (Table 5)."

And Hirano et al. (2020):

> "There was **no clear similarity in the global gene expression profiles between the gall tissue and other tissues**, and *the expression profiles of various biological categories such as phytohormone metabolism and signaling, stress-response pathways, secondary metabolic pathways, photosynthetic reaction, and floral organ development* ***were dramatically altered***. Particularly, ***master transcription factors that regulate meristem, flower, and fruit development, and biotic and abiotic stress-responsive genes were highly upregulated, whereas the expression of genes related to photosynthesis strongly decreased in the early stage of the gall developmen***t. In addition, we found that the expression of **class-1 KNOX genes**, whose ectopic overexpression is known to known to lead to the formation of de novo meristematic structures in leaf, was increased in the early development stage of gall tissue."

As well as Schultze et al. (2019):

> "We extracted RNA from phylloxera leaf galls on *Vitis riparia* at four intervals as they developed (Fig. 2). Aligning reads to the *Vitis vinifera* genome (Version 12 × ; Phytozome Version 7, Joint Genome Institute) allowed us to identify 26,346 grape transcripts expressed in either gall or leaf or both. ***Of these, 11,049 were differentially expressed*** (> 1.5-fold, P < 0.01) at least once in galls compared with ungalled leaves (Fig. 3)."

Let's keep in mind that in the latter paper on phylloxera leaf galls on *Vitis riparia* the authors stated "that phylloxera gall development engages ***portions, but not all, of the floral developmental programs*** in grapevine" – so what is the most important "**rest**" involved in the generation of the entirely new highly specialized ectopic plant gall organs?

In the wake of Schremmers's statement on "the dormant, usually non-appearing form-building abilities [that] can be awakened in the plant" we may continue to define the Darwinian problem as follows:

The enormous amount of absolutely captivating and even mind boggling ***unique forms and structures*** of especially histoid galls, which in these forms and combinations are never occurring anywhere else in the plant hosts, may lead us back to the perhaps most threatening question – menacing at least for "Darwin's Dangerous Idea" (Dennett) – whether there are, in fact, "…"slumbering" abilities in the genetic code of living things that could never prove their advantage in the selection process, but simply be carried along by thousands of generations as a precautionary measure, until someone comes along like a Sleeping Beauty Prince and kisses them awake? And what coincidence [Zufall] should all such skills have provided?"

And all this for, indeed, not only one case, but literally thousands of species of galling insects and plant hosts for which (in virtually each case) "we have unequivocal evidence of a structure occurring in one species ***for the exclusive benefit of another***" (Romanes[128]).

Now, there can be no question that "insect galls are highly specialized plant organs formed by an ***intimate biochemical interaction*** *between the plant and a gall-inducing insect*" (Body et al. 2019 – see above).

This ingeniously complex cross-kingdom interaction between insects and plants reminds perhaps of the "key and lock principle" *sensu lato* (precisely fitting parts made for each other) or as "lock and key": "The combination relies upon the individual fit of a protruding object (the

---

[128] As a believing Darwinian, George Romanes tries to minimize the problem for natural selection stating that "it seems to me ***the one and only case*** in the whole range of organic nature where it can be truly said that we have unequivocal evidence of a structure occurring in one species for the exclusive benefit of another." However, ***the one and only case alone consists of more than 100,000 species***. And there are also other cases.

key) and a receptor (the lock). In biology, an analogous scheme determines the specific reaction of an antigen with an antibody, and between a protein receptor and the target molecule"[129]).

And there seem to be hundreds of such precise keys applied by each galling insect to the correspondingly exactly fitting plant locks.

David Stern from the Department of Plant Sciences of the University of Oxford reports on the question *How aphids induce plant galls* (3 February 2020)[130]:

> "We have discovered that aphids produce **hundreds of homologous novel effector proteins** that they inject directly into plant cells to induce galls. These proteins contribute to **almost total rewiring of the plant transcriptome**, dramatically altering cellular physiology and development. These aphid genes have evolved rapidly, as expected for genes that manipulate host defenses, and the genes encoding these proteins have many unusual properties that may have facilitated their rapid divergence."

The entire process of gall building starts with "gravid females endowed with specialized sensory structures play[ing] a key role in selecting the site precisely for oviposition and thus for the progeny" (Miller and Raman 2019[131]).

Interestingly, in 1995 Stern suggested "that the aphids and other galling insects manipulate ***latent plant developmental programs*** to produce modified ***atavistic plant morphologies*** rather than create new forms de novo".[132]

Well, considering the utmost variability of the morphological forms of plant galls often displaying unrivalled peculiar and strange outfits, even bizarre, with hardly any limits in sight – yet always in strict combination with their exactly tailored systems of functions focusing on the needs of the insects, – my first question would be, which of their assumed ancestors should ever have produced such forms?

"A gall made by *Andricus dentimitratus* covered in red sticky resin. Showing attachment to stem. Growing on *Quercus pyrenaica*": https://commons.wikimedia.org/wiki/File:A_gall_of_Andricus_dentimitratus.JPG (2012)

[129] https://www.encyclopedia.com/science-and-technology/technology/technology-terms-and-concepts/lock-and-key
[130] https://www.plants.ox.ac.uk/event/how-aphids-induce-plant-galls
[131] https://academic.oup.com/aesa/article-abstract/112/1/1/5123572
[132] https://royalsocietypublishing.org/doi/10.1098/rspb.1995.0063

Of course, the variability in plant galls is so overwhelmingly rich that some superficial similarities with certain structures of some postulated atavistic ancestors could probably always be found.

However, in that case, should not algae, mosses, ferns and gymnosperms be the leaders in gall productions? Yet, "about 98 per cent of known gallers affect flowering plants (angiosperms)".

And, although only partially true, what about the "many remarkable flower- and fruit-like traits [that] are seen in galls formed by many insect families and orders on many plant species" (see, however, the limitations in this question of the paper of Schultze et al. above).

Postscript: According to a gall specialist (mail 18 Nov. 2020) possibly gall of *Andricus lignicolus*.
Photo W.-E. L. 7 October 2018

Also, *would not* such assumed often very ancient but still *latent plant developmental programs* thought by Stern *to produce modified atavistic plant morphologies* ***have long been lost*** **during the hundreds of millions of years** of assumed continuous plant evolution and strict natural selection, which was thought to be "daily and hourly scrutinizing, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good"?

So, why did the angiosperms not get rid of this totally superfluous but usually energy expensive ballast/burden/load? And – to use this unpleasant saying – why not "killing two birds with one stone" by (1) abolishing all the latent plant developmental programs for atavistic plant structures ***by the endless billions of random mutations occurring during millions of years*** in the nonfunctional part of the genomes, as well as (2) terminating/eliminating all the services provided by the plants for gall formation resulting "in their own disfigurement" (Malpighi 1679), including stunting, chlorosis, wilting, and even death in the cases of "gall disease" (cecidiosis) due to heavy infestations adversely affecting plants in culture and/or in the wild?

Nevertheless, if one does not absurdly deny the reality of plant galls, Schremmers's statement on "***the dormant, usually non-appearing form-building abilities [that] can be awakened in the plant***", must be undeniably correct. So, also the comment in Strasburger that "cell and organ forms are produced under the influence of a foreign organism, for which ***the genetic potential is present in the plant, but which [cells and organs] are usually not normally formed***."

And, all things considered, Redfern's statement on oak trees that "do not usually produce nectar, so the gall wasp and its extended phenotype must have tapped into ***a developmental pathway that is not normally expressed by the oak***" (Redfern 2011; similarly also Kutsukake et al. 2019[133]) can be generalized to all ***not*** normally expressed and ***un***usually occurring new morphological features and physiological functions of plant species generating especially histoid galls. Yes, there are ***latent plant developmental programs*** producing ***not*** *atavistic* but often ***new plant morphologies*** (see also the authors cited above).

Now, concerning the functional aspects ("Galls provide services") Harris and Pitzschke (2019/2020, p. 1860) mention six themes in their Table 2 as well as their accompanying further detailed comments (see *New Phytologist* **225**: 1852-1872 (2020) [134]).

TABLE 2 of Harris and Pitzschke: Services galls provide for gall-inducers (2020, p. 1860):

NUTRITION (expected for all gall-inducers)
Plant food of higher quality or greater quantity than what the plant normally offers
Food that can only be eaten by the gall associate (e.g. opines as food for *Agrobacterium tumefaciens*[135])
Food that is available over a longer period (e.g. delayed senescence of gall tissue)
Food produced inside plant cells becomes accessible to organisms that live outside cells
(e.g. wall of nutritive cell autolyses, releasing cell contents to insects and mites)
(e.g. sugars exported out of plant cell to *Xanthomonas* species living in extracellular spaces)
PROTECTION (expected for most gall-inducers)
Protection against biotic stress (e.g. predators, parasites, pathogens and competitors)
Protection against abiotic stress (e.g. extreme temperature, humidity, light, salinity)
A suitable place to cultivate fungal symbionts (e.g. gall midges in tribes Asphondyliini and Lasiopterini)
Removal of gall-inducer waste from enclosed chambers (e.g. galling aphids)
TRANSPORTATION (possible for gall-inducers that lack sufficient self-locomotion)
Escape from plant interior to surface (e.g. citrus canker) where other modes of transportation await (e.g. water)
Propulsive escape from plant interior into airstream (e.g. spores ejected from aecial cups of fungal rusts)
Galled tissue recruits winged insects via food rewards or other attractive cues:
(e.g. move gall associate (bacteria, fungi, nematodes, mites) to a fresh host of the same host species)
(e.g. move gall associate (such as phytoplasmas) to a different host plant necessary for completion of life cycle)
REPRODUCTION (expected for all gall-inducers)
Place to build body as an immature form in order to produce many offspring as a free-living adult (insects)
Place for creating generations of descendants that live in and elaborate the gall (e.g. aphids, thrips)
Place to produce infective stages that proceed to attack other plant parts or other plants (e.g. bacteria, fungi)
Place where sexual recombination occurs, giving rise to more virulent host races (e.g. rust fungi on alternate hosts)
A PLACE TO OPTIMIZE COMMUNITY INTERACTIONS (only species living in groups)
A place where division of labor can occur (e.g. soldier castes in gall-inducing aphids and thrips)
Greater opportunities for gaining useful DNA via horizontal gene transfer (HGT) from foreign plant associates
Divide up responsibilities for producing plant-manipulating effectors (e.g. Buonaurio et al. (2015))
A place to share signals for coordinating timing of activities (e.g. attack of host cells and reproduction)
(e.g. signaling by pheromones in bacteria, smut fungi and insects), (e.g. signaling by quorem sensing in bacteria)
(e.g. signaling by quorum sensing within and across bacterial species)
A BETTER WAY TO CONTROL THE PLANT'S OTHER BIOTIC INTERACTIONS
The gall as a 'stronghold' in the plant, from which the gall-inducer can exert greater influence over future colonization of the plant by other species, perhaps beneficial or harmful to the gall-inducer

[133] Similar example and comment by Mayako Kutsukake et al. (2019): "Thus, the trichomes developed in the open galls of the Eriosomatini species are regarded as another example of an extended phenotype of gall-forming social aphids". Plant Manipulation by Gall-Forming Social Aphids for Waste Management. https://www.frontiersin.org/articles/10.3389/fpls.2019.00933/full

[134] https://nph.onlinelibrary.wiley.com/doi/epdf/10.1111/nph.16340

[135] It should perhaps be mentioned that several authors do not include *Agrobacterium tumefaciens* in the plant gall topic.

When studying the author's accompanying text let's further keep in mind that virtually all the services provided by the galls for their guests are formed ***at the exclusive expense of the plant host***, i.e. without any useful return by the animals ("*fremddienliche Zweckmäßigkeit*" (Erich Becher) – not easy to translate, but something like 'extrinsic usefulness', 'disinterested suitability', 'well-directed extraneous utility', closely akin to altruism – see *Abstract* in http://www.weloennig.de/PlantGalls.pdf).

And let's also consider all these themes on the background of Darwin's falsification criterium that "*Natural selection cannot possibly produce any modification in any one species exclusively for the good of another species*; "*… If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection*."

Now Harris and Pitzschke (2020, pp. 1859/1860; all emphasis again by W.-E. L.):

> "**The services plants give to gall inducers** appear under six themes (Table 2). The first is **nutrition**. Better nutrition takes many forms. One is production of a food that can only be eaten by the gall-inducer. Crown galls produce opines that can only be catabolized by the *A. tumefaciens* strain causing the infection. The plant metabolome is remodeled to produce the novel food, as is the primary metabolic response of *A. tumefaciens* to catabolize the novel food (Gonzalez-Mula *et al*., 2019).
>
> A **second theme is protection**. Shelters provide greater stability of abiotic and biotic conditions. ***These benefits are generally assumed for all gall-inducers that are surrounded – entirely or partially – by gall tissue*** (Stone & Schönrogge, 2003; Redfern, 2011). If you live in an enclosed space, **waste disposal** becomes a problem. Galls that accommodate gall-inducing aphids have a solution: the liquid waste produced by hundreds of aphids living inside the gall is absorbed by the inner surface of the gall (Kutsukake *et al*., 2012). Further removal of the waste occurs **via the plant's vascular system**[136].
>
> A **third theme is transportation**. This can be as simple as transport from inside the plant to the outside world. The bacterium citrus canker *Xanthomonas citri* (Table 1) moves from the plant interior to the plant surface when the outer layer of the gall dies and cracks open (Brefort *et al*., 2009). Galls associated with rust fungi are designed to create a force that expels fungal spores into the airstream (Spooner & Roberts, 2005). More sophisticated transport occurs when the gall attracts winged insects, as occurs with leafy galls induced by the phytoplasma *Candidatus asteris* (Sugio et al., 2011; MacLean et al., 2014). Leafhoppers oblige phytoplasmas by providing transport to new plant hosts, but they also serve as hosts themselves.
>
> A **fourth theme is reproduction**. The gall's effect on reproduction by adults is generally a function of greater production of offspring or better accommodations for immature stages. For gall-inducers that produce multiple generations inside a single gall – *bacteria, aphids, and thrips – numbers of offspring generated inside galls can be enormous*. A large leaf pouch gall (Fig. 2) housing 10 000 or more individuals is produced for the pistachio aphid *Baizongia pistaciae* (Wool, 2004).
>
> The **fifth theme is space for communal functions**. In communities, different groups specialize in different tasks. In the insect orders Hemiptera and Thysanoptera (Table 1), soldier castes only appear in species that induce galls (Stern & Foster, 1997; Crespi & Worobey, 2016). Soldiers of the gall aphid *Nipponaphis monzeni* specialize in two tasks: stinging caterpillars that eat the gall and deploying 'social immunity' to plug holes made by caterpillars by communally exploding their bodies (Kutsukake et al., 2019). Galls provide spaces where bacterial communities benefit from quorum sensing and horizontal gene transfer (Jacques et al., 2016).
>
> A **sixth theme is greater control over who else is allowed to colonize the plant**. Having taken up residence in the plant, the plant associate can either make the plant more susceptible or less susceptible to subsequent invaders. Gall inducers have been shown to have this sort of influence (Zgadzaj *et al*., 2016; Lamovsek *et al*., 2017; Kyndt etal., 2017)."

Thus, in a word by Martini et al. 2020, p. 831[137] about insects, a statement which can be generalized to many further gallers: "The **galling insects** create functional compartments in galls, changing the normal structure, chemistry, and physiological features of the host plant **for their own benefit** (Oliveira et al. 2014, Bragança et al. 2016)" – and at the same time ***to the detriment, damage and disadvantage of their plant hosts***[138].

---

[136] See also Kutsukake et al. (2019): "Here, we report a novel gall-cleaning mechanism: **the gall inner surface absorbs and removes the liquid waste through the plant vascular system**. Such a plant-mediated water-absorbing property is commonly found in aphids forming closed galls, which must have evolved at least three times independently." https://www.frontiersin.org/articles/10.3389/fpls.2019.00933/full

[137]https://www.researchgate.net/publication/341521242_Photochemical_performance_and_source-sink_relationships_in_galls_induced_by_Pseudophacopteron_longicaudatum_Hemiptera_on_leaves_of_Aspidosperma_tomentosum_Apocynaceae

Quite captivating are also their introductory comments p. 827: "Gall development on host plant organs has shown convergent morphogenetic steps such as cell hypertrophy and tissue hyperplasia, which create a coordinated gradient of cell expansion and tissue growth (Oliveira and Isaias 2010, Isaias et al. 2011, Carneiro et al. 2014a, Ferreira and Isaias 2014, Oliveira et al. 2016). Thus, galls can be considered to be **new plant organs** induced by galling organisms, especially by insects (Shorthouse et al. 2005). **The metabolism of these neoformed plant organs is deeply changed**, especially in terms of Chl and carotenoid content, enzymatic activity, nutrient composition, carbon and water allocation, as well as photosynthetic performance (El-Akkad 2004, Oliveira and Isaias 2010, Castro et al. 2012, Huang et al. 2014, Oliveira et al. 2017, Rezende et al. 2018)."

[138] Which was also noticed – among many other "classical" authors – already in 1911 by Coulter, Barnes and Cowles in **A TEXTBOOK OF BOTANY** for Colleges and Universities. Vol. II (1911, p. 785): "Unlike most plant structures, ***galls are obviously disadvantageous to the plants of which they form a part***. The energy and material used in their construction, the food which they accumulate and which is utilized by the foreign organisms, together with many activities of the

More than a hundred years ago Erich Becher (1917, p. 46) noted that Otto Porsch[139] had listed the following facilities [Einrichtungen] in plant galls as "absolutely essential for the parasite" – several of these points could be added to the list of Harris and Pitzschke (2020) and conversely a series of their points and themes to the list of Porsch:

1. Separation of the parasite from the outside world.
2. Closure of the entrance to the gall cavity by **interlocking epidermal cells**.
3. Protection of the gall through **rich development of mechanical tissue**.
4. Creation of inner air spaces through the development of a certain type of tissue ("**stellate parenchyma**").
5. Frequent formation of **a special assimilation tissue**.
6. Development of a **continuously regenerating nutritive tissue**.
7. **Location** of nutritive tissue.
8. **Promotion of phloem and xylem to the transport direction of the gall**.
9. **Subsequent formation of new phloem and xylem to the gall**.
10. Abundance of tannins in the gall tissue.
11. Creation of **anatomically predesigned exit gates with an opening mechanism for the exit of the developed animal.**

And Becher adds: "From our considerations it follows that this summary could be expanded; just remember the thorns and spines of some galls."[140]

The data gathered during of the last one hundred years (and more) by hundreds of gall researchers, and – generally – thousands of botanists worldwide, have corroborated Becher's doubts concerning natural selection, stating (1917, p. 90):

> "As has been explained above, we often find in galls the formation of ***tissues and cells that do not occur in normal host plants***. Such novel formations, which are completely lacking in normal host plants and which do not occur except in galls, cannot generally be explained by the principle of natural selection. For something to be selectable, it must first be present, or at least have the ability, the potency, to be activated [in normal plant development under normal environmental conditions].
>
> Let's once again turn our attention to the repeatedly mentioned LINDENGALLE, which ejects its inner gall, i.e. to the self-opening lid and plug galls, which seem to presuppose special potencies of the host plant specifically for gall formation! Here, the principle of selection cannot explain the ***fremddienliche Zweckmäßigkeit*** (as pointed out in *Part I* not easy to translate, perhaps "expediency serving foreign organisms", or "extrinsic usefulness", "disinterested suitability", "well-directed extraneous utility"[141]), because ***the ejection and opening mechanisms of these galls or the corresponding potentials of the host plants must first be there before they can be used***. It is precisely here that we have to explain how the plants came to potencies that do not seem to serve the formation of their normal parts, but seem to have been created especially for the parasites. This is a question that leaves the principle of natural selection at a loss. So we have to look for other explanatory principles.[142]

To repeat: The consequence and well-reasoned inference is, that there are, indeed, "slumbering" abilities in the genetic code of living things that have never proved their advantage for the plant hosts in any selection process. There are, in fact, dormant, usually non-

---

parasites are features of positive detriment. **Thus, galls furnish one of the best illustrations of the *fallacy of the theory of adaptation***" [in plants]. https://books.google.de/books/about/A_Textbook_of_Botany_for_Colleges_and_Un.html?id=80YaAAAAYAAJ&redir_esc=y

[139] Otto Porsch (1915, p. 553): Wechselbeziehungen zwischen Pflanze und Tier: https://archive.org/details/allgemeinebiolog00chun/page/552/mode/2up?q=Porsch

[140] Original German text: "Porsch zählt „als den Schmarotzer unbedingt vorteilhaft" folgende Einrichtungen an Pflanzengallen auf:
1. Abschluss des Schmarotzers von der Außenwelt.
2. Verschluss des Eingangs in die Gallenhöhlung durch Verzahnung der Oberhautzellen.
3. Schutz der Galle durch reiche Entwicklung mechanischen Gewebes.
4. Schaffung innerer Lufträume durch Entwicklung einer bestimmten Gewebeart („Sternparenchym").
5. Häufige Ausbildung eines eigenen Assimilationsgewebes.
6. Entwicklung eines sich stetig ergänzenden Nährgewebes.
7. Lage des Nährgewebes.
8. Förderung der vorhandenen Stoffleitungsbahnen in der Richtung der Stoffleitung zur Galle.
9. Nachträgliche Bildung neuer Stoffleitungsbahnen zur Galle.
10. Gerbstoffreichtum des Gallengewebes.
11. Schaffung anatomisch vorgebildeter Ausgangspforten mit Öffnungsmechanismus für den Austritt des entwickelten Tieres

Aus unseren Betrachtungen ergibt sich, dass diese Zusammenfassung noch erweitert werden könnte; es sei nur an die Dornen und Stacheln mancher Gallen erinnert."

[141] See also http://www.weloennig.de/PlantGalls.pdf pp. 3, 16, 29.

[142] Now also the original German text: "Wir finden, wie oben dargelegt wurde, an Gallen vielfach Bildungen, Gewebe und Zellen, die an den normalen Wirtspflanzen nicht vorkommen. Solche neuartigen Bildungen, die den normalen Wirtspflanzen durchaus fehlen, die außer bei Gallen nicht vorkommen, können aber im allgemeinen nicht durch das Ausnutzungsprinzip erklärt werden; denn damit etwas ausnutzbar sei, muss es zunächst erst einmal vorhanden sein, oder es muss wenigstens die Fähigkeit, die aktivierbare Potenz dazu vorliegen.

Richten wir noch einmal unsere Aufmerksamkeit auf die wiederholt herangezogene, ihre Innengalle ausstoßende Lindengalle, auf die sich selbsttätig öffnenden Deckel- und Stöpselgallen, die besondere Potenzen der Wirtspflanze eigens für die Gallbildung vorauszusetzen scheinen! Hier kann das Ausnutzungsprinzip das Zustandekommen der fremddienlichen Zweckmäßigkeit nicht erklären; denn die Ausstoßungs- und Öffnungseinrichtungen dieser Gallen oder doch die entsprechenden Bildungspotenzen der Wirtspflanzen müssen erst da sein, ehe sie ausgenutzt werden können. Hier gilt es gerade zu erklären, wie die Pflanzen zu Potenzen gekommen sind, die nicht der Bildung ihrer normalen Teile zu dienen scheinen, sondern eigens für die Parasiten geschaffen scheinen. Dieser Frage steht das Ausnutzungsprinzip ratlos gegenüber. Wir müssen uns also nach anderen Erklärungsprinzipien umsehen."

appearing form-building abilities [that] can be awakened in the plant", so that "cell and organ forms are produced under the influence of a foreign organism, for which the genetic potential is present in the plant, but which [cells and organs] are usually not normally formed."

Also, Minelli (2017) was entirely correct to point out that:

> "The gross features of gall morphology are quite probably adaptive from the perspective of the gall-inducing insect, although the sheer diversity of gall forms, including those generated by interactions of closely related insects (e.g., members of the same genus of cynipid wasps or cecidomyid midges) on closely related plant species, suggests ***that many peculiarities of gall morphology are probably neutral for the survival of the growing larva and the eventually reproductive success of the adult into which it will develop***. **What about the adaptive value of these peculiarities from the perspective of the plant? Arguably, none** except for the different cost of producing larger or smaller galls, or different amounts of peculiar metabolites ***that the plant does not produce in normal tissues***. Summing up, there is probably no selection for many structural traits of the gall, and possibly of those that make it conspicuous and morphologically distinct not less than a biological species."

Conclusion reached on the basis of the evidence extensively documented above: Because in the case of the galls, in thousands of plant species often entirely new organs have been formed for the exclusive good of some 132,930 other species, these 'ugly facts' have annihilated Darwin's theory as well as the modern versions of it.

Hence, the problem remains wide open, what "coincidences" should all "such skills have provided?" But before we are going to address this question, let's briefly look at this:

Extended phenotypes of animals *and* plants

"Plant galls represent a unique and complex inter-specific [and inter-kingdom] interaction between the inducer organism and the host plant" (Sahu et al. 2020, p. 1288).[143]

All three photographs of first row: Gall wasp *Cynips quercusfolii* (Linnaeus 1758) according to the three links given below[144]. Below left: the galls of *Cynips quercusfolii* according to "Sanja565658"[145]. Right: From paper by Constantina Chireceanu et al. 2015, p. 33[146].

:

[143] http://www.entomoljournal.com/archives/2020/vol8issue2/PartV/8-2-203-718.pdf

[144] https://www.biolib.cz/en/image/id322261/ https://www.biolib.cz/en/image/id322258/ https://es.wikipedia.org/wiki/Cynips_quercusfolii#/media/Archivo:Cynips.quercusfolii.-.lindsey.jpg Paper: https://www.researchgate.net/figure/The-oak-leaf-gall-of-Cynips-quercusfolii-Diplolepis-rosae-L-1758-Hymenoptera_fig8_282133809

[145] https://commons.wikimedia.org/wiki/File:Cynips_quercusfolii_01.JPG

[146] https://www.researchgate.net/publication/282133809_CONTRIBUTION_TO_KNOWLEDGE_OF_THE_GALL_INSECTS_AND_MITES_ASSOCIATED_WITH_PLANTS_IN_SOUTHERN_ROMANIA

And "insect galls are highly specialized ***plant organs*** formed by an ***intimate biochemical interaction*** between the plant and a gall-inducing insect" (Body et al. 2019). "Galls are modified … naturally developing ***plant structures*** that arise because of messages from certain specialist insects…" (Miller and Raman 2019) – see definitions above.

The basic question is: Are the plant galls displayed above simply inter-kingdom "extended phenotypes" of the gall wasp *Cynips quercusfolii* ***alone*** or are the often adversely affected plants also ***genetically involved*** in this widespread phenomenon?

As shown in detail above, the gall-building success of the insects, mites and other gallers are wholly dependent on the "slumbering" abilities in the genetic code of the plant hosts, i.e. the dormant, usually non-appearing form-building abilities that can be awakened in the plant, or the genetic potential present in the plant for cells and organs that are usually not normally formed. Furthermore, transposable elements may be involved in these processes[147].

Also, the usually strict/severe/inflexible ***host specificity*** of gall-inducing insects (*cf*. Raman above that "nearly 90% of them have been shown to be specific to their hosts"), being also true for fungi and mites, which "are usually ***restricted to one host species or to a few*** in the same genus" (Redfern 2011[148]) may hint on an active genetic involvement of the plants and cannot be explained by an appeal to the fact that "all living things have much in common, in their chemical composition, their cellular structure, their laws of growth, and their liability to injurious influences" (Darwin[149]).

So, I would like to suggest to speak of the ***extended phenotypes of both – of the animals and the plant hosts*** in cooperation – made for each other.

Plant Galls: Darwin, Redfern, and Straton on Natural Selection

In *Part I* of *Plant Galls and Evolution* (http://www.weloennig.de/PlantGalls.pdf) I have cited St. George Mivart and the ensuing discussion in *Nature* (1889/1890) in detail (Mivart: *cf*. pp. 30, 33, 34 and the entire discussion pp. 30-37).

In her otherwise well-researched book, Margaret Redfern takes sides with Darwin, Charles R. Straton and Hermann Adler[150], evidently believing together with many further Darwinians that they have wholly solved the riddle of the origin of plant galls, reporting in a somewhat abbreviated form (2011, Kindle-Version):

> "Adler, in the last quarter of the nineteenth century, was using evolutionary arguments at a time when Darwinian ideas were firmly entrenched but were not universally accepted. Two distinguished biologists, G. J. Romanes and St George Mivart, both considered that galls constituted an obstacle to the theory of evolution by natural selection. Mivart's argument (1889, quoted in Adler & Straton, 1894) ran:
>
> > *Now surely it is too much to ask us to believe that the germ-plasm of the plant, in the first instance, before even, say, a single cynips had visited it, had in the complex collocation of its molecules, an arrangement such as would compel the plant which was to grow from it, to grow those cells and form a gall…It would be very interesting to know how natural selection could have caused this plant to perform actions which, if not self-sacrificing (and there must be some expenditure of energy), are at least so disinterested.*
>
> In other words, the plant is providing benefit for the insect without gaining any advantage in return. Romanes took the same line, but he stressed that it was 'the one and only case' to show such apparent altruism (Cockerell, 1890). Adler tackled these arguments thus:"

---

[147] See several **articles on transposable elements in my List of Publications** http://www.weloennig.de/literatur1a.html (40, 45, 55, 106). Perhaps some points discussed by L. S. Dillon cited in http://www.weloennig.de/AesIV3.Lam.html could also be relevant – should be critically investigated.
[148] Redfern, Margaret. Plant Galls (Collins New Naturalist Library, Book 117). HarperCollins Publishers. Kindle-Version.
[149]http://darwin-online.org.uk/Variorum/1859/1859-484-dns.html
[150] Hermann Adler (1894): Alternating Generations. A Biological Study of Oak Galls and Gall Flies By Hermann Adler, M. D. Schleswig [-Hostein]. Translated and Edited by Charles R. Straton. Oxford At the Clarendon Press. Darwin quoted here: https://archive.org/details/alternatinggene00adle/page/n7/mode/2up?q=Darwin

I'm now reproducing the decisive parts of the original pages from the *Introduction* by *Charles R Straton (not Adler)* telling his readers (1894, pp. xxxii-xxxiv, in part also quoted by Redfern, including that directly below):

It is next of interest to inquire how the various structures of the gall came to be evolved. It may be taken as perfectly certain that the tree does not form them in a disinterested manner for the sake of the Cynips. Darwin says: 'If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection [2].' So far as galls are concerned, Darwin's theory is perfectly safe. The 'excitatory emanations,' as Professor Romanes [3] aptly calls them, which lead to gall-growth, can only have arisen by gradual and increasing improvements in the initial stages of their formation, acting through natural selection, over an unlimited period of time, and through numerous consecutive species

Redfern comments on this paragraph:

> "Adler classified oak galls into five groups of increasing structural complexity that illustrate an evolutionary sequence (the names of most of these insects have changed (see Appendix A; the structure of some of the galls is described in Chapter 9)":

Note, however, that Charles R. Straton (not Adler[151]) states that "Beyerinck's classification following that of Lacaze-Duthiers [published in 1853, i.e. 6 years before Darwin's *Origin*], is into five groups: – "

Classification of Galls. xxxiii

Galls may be arranged in groups of gradually increasing complexity, beginning with those like *Spathegaster baccarum*, and leading up to the complicated structure of *Cynips Kollari*. Beyerinck's classification following that of Lacaze-Duthiers, is into five groups:—

1. Simple galls, consisting of nutritive tissue enclosed in thin-walled parenchyma with vascular bundles:
   Neuroterus ostreus, Spathegaster albipes, S. baccarum, S. Aprilinus.
2. Galls similar to these, but having the nutritive tissue first enclosed in sclerenchyma, which forms an 'inner gall':
   Neuroterus lenticularis, N. laeviusculus, N. numismatis, N. fumipennis, Aphilotrix Sieboldi, A. autumnalis, A. radicis, A. globuli, Andricus curvator, Biorhiza renum, B. aptera.
3. Galls possessing an inner gall like the last, but having it surrounded by thick-walled parenchyma:
   Dryophanta longiventris, D. divisa.
4. Galls with the inner gall enclosed in a spongy layer of branched parenchyma, with wide intercellular spaces, and having the surface covered with a differentiated epidermis:
   Unilocular. *Dryophanta scutellaris.*
   Multilocular. *Teras terminalis.*
5. Galls which have the inner gall enclosed in thick-walled parenchyma, and then in spongy tissue; and which have a differentiated epidermis:
   Cynips Kollari.

Besides these histological differences, the outward characters are also of varying complexity; each infinitesimal improvement, which has been of service as a protection against parasites, or has been successful in securing natural conditions favourable to the life and

c

xxxiv *Introduction.*

growth of the larva, has been preserved, and has formed the starting-point of further beneficial variations. It is always that larva which has been able to induce successful morphological abnormalities, which is reproduced to continue the race; the unsuccessful perish. The ruling force is natural selection; it is impossible that intelligence or memory can be of any use in guiding the Cynipidae; no Cynips ever sees its young, and none ever pricks buds a second season, or lives to know the results that follow the act. Natural selection alone has preserved an impulse which is released by seasonally recurring feelings, sights, or smells [1], and by the simultaneous ripening of the eggs within the fly. These set the whole physiological apparatus in motion, and secure the insertion of eggs at the right time, and in the right place. The number of eggs placed is instinctively proportionate to the space suitable for oviposition, to the size of the fully grown galls, and to the food supplies available for their nutrition. *Dryophanta scutellaris* will only place from one to six eggs on a leaf which *Neuroterus lenticularis* would probably prick a hundred times. The veins and petiole of the leaf carry onwards water and salts derived from the soil, and return the organic products of the leaf-cells; and these food currents render them desirable situations for gall-growth. The under surface of the leaf is folded outwards in the bud (vernation conduplicate), so that it is the first part reached, when buds are pricked. When expanded leaves are pricked, the spongy mesophyll of the under surface is much more easily penetrated than the upper surface, which is covered with the cuticle of an epidermis, that rests on closely

[1] Weismann, *Essays on Heredity*, vol. i p. 95.

Evolution of Galls. xxxv

packed palisade cells; the lower surface is consequently the situation most in favour.

Whatever form the gall takes, the potentialities of the tissue-growth exhibited by it, must be present at the spot pricked by the fly. It is not necessary to assume, with De Vries, that every vegetable cell contains the potentialities of every other cell in a latent condition. The conical growing point in every bud contains the germ-plasm of the next shoot, and consequently of the whole plant.

The potentialities of growth being present, they are called into activity by the larva, a result advantageous to the larva and sometimes described as disinterested and self-sacrificing on the part of the plant [1]. We have just seen that, so far as the larva is concerned, the peculiar structures of the gall owe their origin to their success in feeding and defending it; and so far as the plant is concerned, these structures have been evolved in consequence of their value in enabling the plant to repair injuries in general, and the injuries inflicted by larvae in particular. If John Doe raises a cane to strike Richard Roe, and Richard throws up his arms intuitively to parry the stroke, the action does not indicate a prophetic arrangement of molecules to frustrate John in particular, but an inherited action of defence. The first act of an injured plant is to

[1] St. George Mivart, *Nature*, Nov. 14. 1889. 'Now surely it is too much to ask us to believe that the germ-plasm of the plant, in the first instance, before even, say, a single cynips had visited it, had in the complex collocation of its molecules, an arrangement such as would compel the plant which was to grow from it, to grow those cells and form a gall.' And in a note he adds: 'It would be very interesting to know how natural selection could have caused this plant to perform actions which, if not self-sacrificing (and there must be some expenditure of energy), are at least so disinterested.'

c 2

[152]

After quoting the five points from the *Introduction* by Straton p. xxxiii (reproduced left above), Redfern continues:

> "He suggested that this sequence shows gradual improvements in providing favourable conditions for the larvae and protection against parasites, with each change arising by natural selection. Thus, there is nothing altruistic in the formation of the gall. The insect is exploiting the normal response of the plant to an injury by converting the wound tissue so formed into nutritive and protective tissue."

[151] Unfortunately I could not check the original German text of Adler's paper so far. So, I cannot say whether he defended Darwin in his original book in the same way (or in any way) as Straton. In the English edition Darwin is only mentioned in the introduction by Straton (six times), but not in the main text authored by Adler (Hermann Adler (1881): Über den Generationswechsel der Eichen-Gallwespen. Zeitschrift für wissenschaftliche Zoologie **35**, 1881: 151-246) translated by Straton.

[152] See rest of the last sentence ("The first act of an injured plant is…") below in the discussion.

Then she goes on to cite from p. xxxviii:

> "*….Darwin and all writers before him held that force calling out gall formation was due to a chemical secretion injected by the gall mother…Darwin speaks of galls as produced '**by a minute atom of the poison of a gall-insect'**, and compares them to the specific local processes of zymotic [infectious] diseases.*"

And subsequently comments:

> "He continued that 'the most reasonable, if the only reasonable theory, is that each insect infects or inoculates the leaf or other structure of the chosen plant ***with a poison peculiar to itself***'. This is generally accepted today. Adler showed in addition that the larva and particularly its salivary secretion is necessary for the gall to develop. The debate on why the elaborate structure of galls develops continues today (see Chapter 11)."

No, not "He…" (Darwin) but "Sir James Paget, writing in 1880, said that 'the most reasonable…"[153] – although Darwin, indeed, referred to "a minute atom of the poison of a gall-insect"[154] and used the term "poison" in gall contexts some twenty times in his books (for a more detailed documentation in http://www.weloennig.de/PlantGalls.pdf).

Now, let's analyze Straton's text and Redfern's comment on it in detail (**M. R.** for Margaret Redfern):

1. **M. R.**
   "Adler, in the last quarter of the nineteenth century, was using evolutionary arguments at a time when Darwinian ideas were firmly entrenched but were not universally accepted. Two distinguished biologists, G. J. Romanes and St George Mivart, both considered that galls constituted an obstacle to the theory of evolution by natural selection. Mivart's argument (1889, quoted in Adler & Straton, 1894) ran:…"

W.-E.L.:
As far as I could find out, it was not Adler, but Straton who "was using evolutionary arguments at a time when…"
Correct is, however that "two distinguished biologists, G. J. Romanes and St George Mivart, both considered that galls constituted an obstacle to the theory of evolution by natural selection" – correctly/rightfully so (see arguments and facts presented above) the Darwinian Romanes and (according to a formulation of Abrahamson and Weiss) "Darwin's most nettlesome critique" Mivart. It seems that these two acclaimed biologists had really understood the deep problem plant galls have proved to be for natural selection.

2. **M. R.** quoting Mivart's argument:

> "*Now surely it is too much to ask us to believe that the germ-plasm of the plant, in the first instance, before even, say, a single cynips had visited it, had in the complex collocation of its molecules, an arrangement such as would compel the plant which was to grow from it, to grow those cells and form a gall.*"

W.-E. L.:
To repeat: The basic question is: Are the plant galls displayed above simply inter-kingdom "extended phenotypes" of the gall wasp *Cynips quercusfolii* alone or are the often adversely affected plants also genetically involved in this widespread phenomenon?

As shown in detail above, the gall-building success of the insects, mites and other gallers are wholly dependent on the "slumbering" abilities in the genetic code of the plant hosts, i.e. the dormant, usually non-appearing form-building abilities that can be awakened in the plant, or the genetic potential present in the plant for cells and organs that are usually not normally formed.

So, is it indeed, too much to ask us to believe that "*that the germ-plasm of the plant, in the first instance, before even, say, a single cynips had visited it, had in the complex collocation of its molecules, an arrangement such as would compel the plant which was to grow from it, to grow those cells and form a gall*"?

3. **M. R.** continues to quote Mivart as follows and comments:

> "*…It would be very interesting to know how natural selection could have caused this plant to perform actions which, if not self-sacrificing (and there must be some expenditure of energy), are at least so disinterested.*"

"In other words, the plant is providing benefit for the insect without gaining any advantage in return."

W.-E. L.:
Exactly! Or, as Professor Joachim Illies from the Max Planck Institute in Plön has put it (without directly touching the topic of disinterest):

> "*For the plant, the entire effort involved in the gall formation is of no apparent benefit, it is more of a harm because it requires nutrients, reduces the assimilating leaf area and disrupts the normal course of growth, **sometimes even the most valuable parts of the plants: buds and seeds**. Consequently, according to Darwin, the plants without galls should have an advantage over those with galls, and so in the course of evolution **the gall-free variants among the plants should have been chosen very soon and everywhere as the fittest ones*** [*which obviously is not the case*]."

[153] See page xxxviii in https://archive.org/details/alternatinggene00adle/page/n45/mode/2up
[154] 1868, p. 418: http://darwin-online.org.uk/content/frameset?itemID=F877.2&viewtype=text&pageseq=1

M. R. Romanes took the same line, but he stressed that it was 'the one and only case' to show such apparent altruism (Cockerell, 1890).

W.-E. L.: As mentioned above: As a believing Darwinian, George Romanes tries to minimize the problem for natural selection… However, "***the one and only case" alone consists of more than 100,000 species***. And there are also other cases.

M. R. "Adler tackled these arguments thus:"

W.-E. L.:
Again: It seems to have been Straton, not Adler but perhaps Adler consented.

4. **M. R. citing Straton** (from now on **C. R. S.** for Charles R. Straton):
"It is next of interest to inquire how the various structures of the gall came to be evolved. It may be taken as perfectly certain that the tree does not form them in a disinterested manner for the sake of the *Cynips*,

W.-E. L.:
Well, of course, a tree is not a conscious being and thus cannot form galls in a disinterested manner for any insect. Nevertheless, on closer inspection the question touches on both, the origin of trees and of insects – if there are any scientifically testable reasons to assume that design is involved, the entire approach changes immediately and dramatically. In that case, insects and trees could be "made for each other" so that the plants bearing the load against and above natural selection in favor of clear advantage for the insects.

5. **C. R. S.** continues:
"Darwin says: 'If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection -.' So far as galls are concerned, Darwin's theory is perfectly safe."

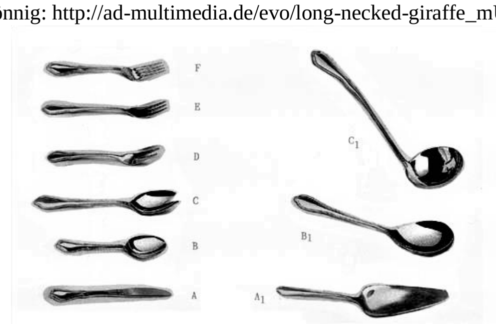
W.-E. L.:
Now: "So far as galls are concerned, Darwin's theory is perfectly safe". ***This seems to be nothing but a dogmatic statement showing that Straton did not even ahnen (not to speak of understanding) the deep problem that galls represent for the theory of natural selection***.

6. **C. R. S.** goes on to say:
"The 'excitatory emanations,' as Professor Romanes aptly calls them, which lead to gall-growth, can only have arisen by gradual and increasing improvements in the initial stages of their formation, acting through natural selection, over an unlimited period of time, and through numerous consecutive species."

W.-E. L.:
How can such assertions ever be scientifically tested? How does Straton "know" that the 'excitatory emanations' leading to gall growth "can only have arisen ***by gradual and increasing improvements in the initial stages of their formation***…"? Why, then, do almost 99% of all insect species survive and flourish well and successfully without any gall building at all? "… acting through natural selection…" So, why did natural selection in all the assumed (altogether) hundreds of millions of years forgot the affected plant hosts (see again Illies as quoted above). "…over an unlimited period of time…" Although, according to the geological time scale, for hundreds of millions of years, – nevertheless for the angiosperms as well as for all the other plant groups ***the time scale is clearly limited***.

7. **C. R. S.**:
Galls may be arranged in groups of gradually increasing complexity, beginning with those like *Spathegaster baccarum*, and leading up to the complicated structure of *Cynips Kollari*. Beyerinck's classification following that of Lacaze-Duthiers, is into five groups : —

W.-E. L.: This proves nothing: Almost any larger assemblage of varying forms can "be arranged in groups of gradually increasing complexity". Crude example (see also Lönnig: http://ad-multimedia.de/evo/long-necked-giraffe_mU.pdf p. 59):



Derivation of the fork from the knife, through the spoon, and the special evolution of the soup ladle from the cake slicer. One may note especially the stepwise perfection in the fork development from the 2-pronged meat fork (D) through the 3-pronged kitchen fork (E) to the 4-pronged dining fork (F). The salad server is the intermediate link between spoon (B) and meat fork (D) (mosaic evolution!). One only needs to assume that everything is derived from primitive knives.

8. **C. R. S.**:

"1. Simple galls, consisting of nutritive tissue enclosed in thin-walled parenchyma with vascular bundles: *Neuroterus ostreus, Spathegastcr albipes, S. baccarum, S. Aprilinus*.

2. Galls similar to these, but having the nutritive tissue first enclosed in sclerenchyma, which forms an ' inner gall ': *Neuroterus lenticularis, N. laeviusculus, N. numismatis, N . fumipennis, Aphilotrix Sieboldi, A. autumnalis, A. radicis, A. globuli, Andricus curvator, Biorhiza renum, B. aptera*.

3. Galls possessing an inner gall like the last, but having it surrounded by thick-walled parenchyma: *Dryophatita longiventris, D. divisa*.

4. Galls with the inner gall enclosed in a spongy layer of branched parenchyma, with wide intercellular spaces, and having the surface covered with a differentiated epidermis: Unilocular. *Dryophanta scutellaris*. Multilocular. *Teras tcrminalis*.

5. Galls which have the inner gall enclosed in thick-walled parenchyma, and then in spongy tissue; and which have a differentiated epidermis: *Cynips Kollari*."

W.-E. L.:

And they live all together happily and "flourish" on oak or other trees (often also not only on the same tree but also side by side on the same leaf) – ***quite independently of their often strongly different levels of complexity and differentiation***. So why did natural selection stop in so many cases as with 1. "simple galls, consisting of nutritive tissue enclosed in thin-walled parenchyma with vascular bundles". Similar questions for 2. To 5. Es geht so aber auch anders (famous botanist Karl Göbel….variability larger then environmental factors)

9. **C. R. S.**:

"Besides these histological differences, the outward characters are also of varying complexity; each infinitesimal improvement, which has been of service as a protection against parasites, or has been successful in securing natural conditions favourable to the life and growth of the larva, has been preserved, and has formed the starting-point of further beneficial variations."

W.-E. L.:

"…each infinitesimal improvement, which has been of service as a protection against parasites…": Infinitesimal improvements are usually not noticed by natural selection (*cf*. details in Lönnig: Natural selection: Links).

And let's now turn to the present situation: ***Fact is that even the insects generating the simplest galls successfully survive side by side with those producing the most complex ones!*** – Could there not be something deeply wrong with the Darwin's selection theory?

10. **C. R. S.**:

"It is always that larva which has been able to induce successful morphological abnormalities,…"

W.-E. L.:

This does not explain how "always that larva" obtained the ability to successfully induce 'morphological abnormalities'. Question: Just by accidental variations (or in neo-Darwinian terms random DNA mutations) independently arisen dozens of times in "at least the following seven orders: Thysanoptera, Hemiptera, Homoptera, Lepidoptera, Coleoptera, Diptera, and Hymenoptera" (see citation above)? Untestable hypothesis outside science! Darwin, Straton and nowadays the neo-Darwinians regularly presuppose what should be addressed and explained. As for the term "abnormalities": Although there are many abnormalities, even teratological aberrations ("ugly facts"), it would be certainly not correct to reduce successful gall induction and formations altogether to morphological ***abnormalities***. See definitions etc. above and *Abstract* and further points in http://www.weloennig.de/PlantGalls.pdf.

Abnormalities in Adler checken!

Let's keep in mind, please, that 'as documented in *Plant Galls I*, many authors speak even of "***new organs***" (p. 9). Recall also Harper et al (2004): *Cynipid galls: insect-induced modifications of plant development create* ***novel plant organs***,[155] Body et al. (2019) talk of "***highly specialized plant organs***", Schultz et al. (2019) refer to "***unique organs***", Harris and Pitzschke (2020) to "***de novo plant tissue or organ***", Martini et al. (2020) "***neoformed plant organs***"[156], Minelli (2017) speaks of an "***ectopic organ***" and Strugger already in 1963 of "*völlig neue Formbildungen*", i.e. ***entirely new generation of forms***.'

11. **C. R. S.**:

"…which is reproduced to continue the race; the unsuccessful perish. The ruling force is natural selection;…"

W.-E. L.:

"…the unsuccessful perish": ***More than 5 million insect species do not induce any plant galls at all and yet survive, persist and victoriously live on*** instead of perishing and passing away. Many of them pure vegetarians.

---

[155] https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-3040.2004.01145.x

[156] https://www.researchgate.net/publication/341521242_Photochemical_performance_and_source-sink_relationships_in_galls_induced_by_Pseudophacopteron_longicaudatum_Hemiptera_on_leaves_of_Aspidosperma_tomentosum_Apocynaceae (p.872)

[156] Footnote: Original German text:

"The ruling force is natural selection": Concerning the possibilities ***and limits*** of natural selection I would like to refer the reader to, for example, to the following articles, discussions and podcast:
http://www.weloennig.de/NaturalSelection.html
http://www.weloennig.de/jfterrorchipmunks.pdf
http://www.weloennig.de/OmnipotentImpotentNaturalSelection.pdf
https://www.discovery.org/multimedia/audio/2016/04/paul-nelson-wolf-ekkehard-lonnig-randomness-in-natural-selection/
Thus, there can be no doubt that there is a strong element of chance in natural selection.
Also, natural selection is limited by ever occurring random events, irreducible complex structures and (generally) by the law of recurrent variation.

Biologist Lima de Faria on the often used neo-Darwinian method of problem solving (MOLECULAR EVOLUTION AND ORGANIZATION OF THE CHROMOSOME; 1983; 1186 pp.): "What I am trying to convey is that due to the absence of knowledge of molecular mechanisms, selection has been employed like a kind of general remedy by the biologist. Every time a phenomenon appeared in biology, and one obviously ignored its mechanism, selection was invoked as an explanation and the matter was settled". *Cf.* http://www.weloennig.de/AesIV2.B.6.html

12. **C. R. S.**:

"…it is impossible that intelligence or memory can be of any use in guiding the Cynipidae; no *Cynips* ever sees its young, and none ever pricks buds a second season, or lives to know the results that follow the act."

W.-E. L.:

One of the fundamental problems for the theory of "gradually increasing complexity" by 'infinitesimal improvements' also found regularly in plant galls has been well worked out by Oskar Kuhn for the case of *Bruchus pisi*, the pea beetle, as follows:

> "How does Lamarck's or Darwin's theory of descent [or that of our contemporary neo-Darwinians] explain the following? The female of the pea beetle lays her eggs on the pods of young peas. The hatching larvae pierce the pods and penetrate the peas that are still soft. The larva that has penetrated to the center of a pea lives on, the other less deeply penetrated larvae perish. Now the larva hollows out the pea inside, drills a passage to the surface and at the end scratches the skin of the pea all around so that a door is created; then the larva retreats back into its feeding cavity and continues to grow; the pea, however, has become hard in the meantime. Therefore, the larva has created the passage with the door as ***a precaution so as not to be trapped and buried alive by the hardened pea***. In this case, there is no use in ancestral experience based on trial and error. Any attempt to get out of the hardened pea would prove to be unsuccessful. The construction of the tunnel and door must rather be in the formation plan of the larva of the pea beetle [from the very beginning]. Such examples can be given in great numbers [Fabre has described numerous such cases in his *Souvernirs Entomologiques*]; ***Not a single one of these cases from animal biology can be explained by the cumulative theory of descent***. Here is what has been called primary expediency. "

So, how, then, would Straton (or our present-day neo-Darwinians) explain the following similarly constituted examples in plant galls?:

(a) "The round gall capsules of the South American anacardia *Duvalia* finally form the loopholes for their subtenants (the larva of the moth *Cecidosis eremita*), the lids of which loosen in time and thus free the way for the larvae, which it would not be able to clear on its own!" – The exit opens exactly at the right time and in the optimal form – so that the parasite can easily press it out when ready for pupation. Unable to learn anything, how did *Cecidosis eremita* leave its home before the exit was ready in time, finished in form and function? And the affected plants?

Now the following similarly constituted examples according Bellmann, Spohn and Spohn (2018): *Faszinierende Pflanzengallen*. Quelle & Meyer Verlag Wiebelsheim (original text in German see at the end of the article).

(b) *Pterotopteryx dodecadactyla*: "Twig of host plant [*Lonicera xylosteum*] swollen spindle-shaped to a length of 2-3 cm. Inside the branch a feeding tunnel with reddish coloured butterfly caterpillar. Before pupation the caterpillar bores an exit through which the hatching butterfly later leaves the branch" (p. 203). ***How did it leave the gall before it had prepared the necessary exit***?
(c) *Adelges viridis*: "In June or July the gall opens like a fissure at the edges of the adhesions [spaltförmig an den Verwachsungsrändern] and releases the flying animals" (p. 229).
(d) *Paranthrene tabaniformis*: "...before the butterfly hatches, the pupa pushes itself outwards through a hatching hole previously gnawed by the caterpillar..." (p. 258).
(e) *Andricus foecundatrix*: "…opens in the manner of a rose flower..." (p. 288) to eject the inner gall.
(f) *A. quercuscorticis*: "...gall lid dries in autumn and falls off..." (p. 304).
(g) *Andricus quercustozae*: "…At maturity in October or November they [the galls] push further and further out of the bud, only to fall to the ground. The larva pupates in the gall on the ground" p. 307. ("Baumwollgalle")
(h) *Andricus testceipes* "...but the wasps ...spend the winter in the gall before leaving it through a hole in the side in February or March of the 3rd year" (parthenogenetic generation p. 311).
(i) *Cynips quercusfolii*: "….The wasp often hatches from the pupa as early as October, and initially gnaws a hatch just below the gall surface. Between November and March, when the weather is favourable, it then leaves its quarters to lay its eggs in buds" (p. 322).
(j) *Didymomyia tiliacea*: "**…**Colouring green in the middle, often bright red at the edges. Finally, on the more upright side, the central part is delimited by a circular furrow, turns brown (**B**) and gradually pushes up like a cork (**C**) until it becomes completely detached and falls to the ground. In this cork-shaped inner gall is the whitish or light yellow larva, which finally pupates on the ground. After the inner gall has fallen off, the hollowed-out rest of the gall remains on the leaf (**A**, bottom centre of picture)" (p. 419). For the photogarphs I have to turn the attention of the reader to that book.

Comment by Erich Becher on such phenomena: "Now, however, there is also the fact that the host plant not only ties the gall guest to a certain place by covering it and providing local nutrients, but also does many benefits to its enemy. Is it supposed to be useful for the host plant if it caused by hard layer formation, tannin production, thorn development and the like? the like. shields your enemy in the gall?

It seems to be more advantageous for them if they attract animals with their striking, fruit-like coloring, etc., ***to consume the gall and thus destroy the ungrateful guest***. ***But it is precisely against attack by hungry animals that the galls and their occupants appear to be protected in many ways***. *And why do some galls provide their guests* ***with a convenient way out at the right time by opening automatically***? Is it done to avoid being injured by the animal that would otherwise break through with its eating tools?

However, even with the automatic opening of pouch galls and other galls that completely enclose their cecidozoa, and when looking at the openings made by the inhabitants of the gall, one does not get the impression that the opening procedure harms the host plants. If I compare the hole created by the parasite in the spherical oak gall of the gall wasp *Cynips Kollari* with the plug hole in the spherical gall produced by ***Cecidosis eremita*** on the branches of ***Duvalia longifolia***, I am not convinced that the automatic gall opening is noticeable avoiding harm. Compared to the rest of the damage caused by loss of substance, the damage caused by the opening procedure is probably not considerable at all. Finally, let's look again at the gall produced by *Hormomyia Réaumuriana* on the leaf of the large-leaved linden (or the similar gall on the leaf of a Brazilian *Celastrus* species)! What use should the linden tree have from the separation and expulsion of the plug-like internal gall? It is not possible simply to postulate purely for the sake of the principle of selection in the gall devices self-serving expediency or expediency serving the species, where only expediency for others can be seen."

No convincing explanations by Straton or other Darwinians and/or present day neo-Darwinians up to now.

And what about the following more detailed example of the problems of natural selection analyzed by **Jean Henry Fabre analyzing *THE METHOD OF THE AMMOPHILAE*** displaying a behavior/instinct of insect species that likewise never see and could have been learned by way of its descendants: http://www.efabre.net/chapter-xi-the-method-the-ammophilae or here: https://www.gutenberg.org/files/3462/3462-h/3462-h.htm#link2HCH0012 (unfortunately too long to be reproduced directly here). But to rouse the appetite of my readers, just a rather short quotation from that fascinating chapter:

"Darwin, a true judge, made no mistake about it (5). He greatly dreaded the problem of the instincts. My first results in particular left him very anxious. If he had known the tactics of the Hairy Ammophila, the Mantis-hunting Tachytes, the Bee-eating Philanthus, the Calicurgi and other marauders, ***his anxiety, I believe, would have ended in a frank admission that he was unable to squeeze instinct into the mould of his formula***. Alas, the philosopher of Down quitted this world when the discussion, with experiments to support it, had barely begun: a method superior to any argument! The little that I had published at that time left him with still some hope of an explanation. In his eyes, instinct was always an acquired habit. The predatory Wasps killed their prey at first by stabbing it at random, here and there, in the softest parts. By degrees they found the spot where the sting was most effectual; and the habit once formed became a true instinct. Transitions from one method of operation to the other, intermediary changes, sufficed to bolster up these sweeping assertions. In a letter of the 16th of April, 1881, he asks G. J. Romanes to consider the problem:

„I do not know," he says "whether you will discuss in your book on the mind of animals any of the more complex and wonderful instincts. It is unsatisfactory work, as there can be no fossilised instincts, and the sole guide is their state in other members of the same order, and mere PROBABILITY.

„But if you do discuss any (and it will perhaps be expected of you), I should think that ***you could not select a better case than that of the sand-wasps which paralyse their prey as described by Fabre*** in his wonderful paper in the "Anales des sciences naturelles," and since amplified in his admirable „Souvenirs…"

I thank you, O illustrious master, for your eulogistic expressions, proving the keen interest which you took in my studies of instinct, no ungrateful task — far from it — when we tackle it as it should be tackled: **from the front, with the aid of facts, and not from the flank, with the aid of arguments**. Arguments are here out of place, if we wish to maintain our position in the light. Besides, where would they lead us? To evoking the instincts of bygone ages, which have not been preserved by fossilization? Any such appeal to the dim and distant past is quite unnecessary, if we wish for variations of instinct, leading by degrees, according to you, from one instinct to another; the present world offers us plenty."

In the following (and more) analyses he brilliantly shows the ***utter impotence of natural selection*** to convincingly explain these phenomena. In principle such cases con be extrapolated to the instincts of gall insects mentioned above.

Incidentally, I am also fond of the ensuing instance although perhaps only indirectly interesting in our plant gall context as far as specialization and dependence on one food source is involved (just another excerpt from a much more detailed exposition):

"….Every attempt led to the invention of a new dish, an important event, according to the masters, an inestimable resource for the family, who were thereby delivered from the menace of death and enabled to thrive over large areas whence the absence or rarity of a uniform game would have excluded it. And, after making use of a host of different viands in order to attain the culinary variety which is to-day adopted by the whole of the Sphex nation, lo and behold, each species confines itself to a single sort of game, outside which every specimen is obstinately refused, not at table, of course, but in the hunting-field! By your experiments, from age to age, to have discovered variety in diet; to have practised it, to the great advantage of your race, and to end up with uniformity, the cause of decadence; to have known the excellent and to repudiate it for the middling: oh, my Sphex-wasps***, it would be stupid if the theory of evolution were correct***!

To avoid insulting you and also from respect for common sense, I prefer therefore to believe that, if in our days you confine your hunting to a single kind of game, ***it is because you have never known any other***. ***I prefer to believe that your common ancestress, your precursor, whether her tastes were simple or complex, is a pure chimera***, for, if they were any relationship between you, having tested everything in order to arrive at the actual food of each species, having eaten everything and found it grateful to the stomach, you would now, from first to last, be unprejudiced consumers, omnivorous progressives. I prefer to believe, in short, that the theory of evolution is powerless to explain your diet. This is the conclusion drawn from the dining-room installed in my old sardine-box." [157]

---

[157] Release Date: February 12, 2009 [EBook #3462] Last Updated: January 22, 2013. Translator: ALEXANDER TEIXEIRA DE MATTOS.Ventnor, I. W., 6 December, 1920. See more on https://www.gutenberg.org/files/3462/3462-h/3462-h.htm#link2HCH0009

So far I have never heard any convincing explanation of our present day neo-Darwinians explaining "everything" by random mutations and natural selection.

13. **C. R. S.**:

"Natural selection alone has preserved an impulse which is released by seasonally recurring feelings, sights, or smells and by the simultaneous ripening of the eggs within the fly."

W.-E. L.:

This appears to be a scientifically rather vacuous attempt of an explanation for the origin of plant galls. Apart from the fact that something like the omnipotence of natural selection[158] is presupposed by Straton ("natural selection alone"), we may ask, for example: What exactly did natural selection act upon? Selection values? How often?

"An impulse"? – Which was or of what consisted the "impulse" that was "released by seasonally recurring feelings, sights, or smells"? Which DNA mutation(s) (and how many) have caused that evidently ***new*** impulse as compared to that of all the other more than 5,000,000 insect species without any gall triggering abilities?

"…seasonally recurring feelings, sights, or smells…". Some biologists have argued that insects don't have any feelings comparable to that of humans (see discussion in http://www.weloennig.de/JoachimVetter.pdf and the opinion of Alfred Russel Wallace [regarded as Darwin's co-discoverer of the principle of natural selection; father of modern biogeography] http://www.weloennig.de/Wallace.pdf).

"…by the simultaneous ripening of the eggs within the fly": So this undefined "impulse" is also assumed to have been correlated in time with "the simultaneous ripening of the eggs…" – could be called "faith" in random events in the DNA code exercising their effects for gall building correctly in space and time.

14. **C. R. S.**:

"These set the whole physiological apparatus in motion, and secure the insertion of eggs at the right time, and in the right place. The number of eggs placed is instinctively proportionate to the space suitable for oviposition, to the size of the fully grown galls, and to the food supplies available for their nutrition. *Dryophanta scutellaris* will only place from one to six eggs on a leaf which *Neuroterus lenticularis* would probably prick a hundred times."

W.-E. L.:

"These…" , i. e. the unexplained gall forming "seasonally recurring feelings, sights, or smells" in correlatiom with the equally unaccounted for "simultaneous ripening of the eggs within the fly" due to omnipotent "natural selection alone", which is assumed to have preserved an unexplained "impulse" securing the insertiom of eggs by a likewise totally unexplained instinct doing everything correctly in appropriate numbers at the right time, and in the right place.

Or in the words of Prof. F. Schmidt: "Neo-Darwinism has only put the **god of chance** in the place of a divine creator, who is just as omnipotent, omniscient and omnipresent. He can do everything: He makes countless of the most amazing inventions. He knows everything: He is a master of all biochemical, biophysical and biological laws and puts all scientific achievements in these areas far into his shade. He is in action everywhere and yet it is invisible - invisible and incomprehensible in the truest sense of the word. Even his origin resembles that of a god: he too is immortal and has always been there.[159]

15. **C. R. S.**:

"The veins and petiole of the leaf carry onwards water and salts derived from the soil, and return the organic products of the leaf-cells; and these food currents render them desirable situations for gall growth. The under surface of the leaf is folded outwards in the bud (vernation conduplicate), so that it is the first part reached, when buds are pricked. When expanded leaves are pricked, the spongy mesophyll of the under surface is much more easily penetrated than the upper surface, which is covered with the cuticle of an epidermis, that rests on closely packed palisade cells; the lower surface is consequently the situation most in favour."

W.-E. L.:

Well formulated but absolutely no testable explanation how all these phenomena came about by the theory of "gradually increasing complexity" by 'infinitesimal improvements', or in contemporary neo-Darwinian terms, random mutations and natural selection.

---

[158] *Cf.*, if you like to do so, again: http://www.weloennig.de/OmnipotentImpotentNaturalSelection.pdf
http://www.weloennig.de/NaturalSelection.html
http://www.weloennig.de/jfterrorchipmunks.pdf
https://www.discovery.org/multimedia/audio/2016/04/paul-nelson-wolf-ekkehard-lonnig-randomness-in-natural-selection/

[159] Original German text: „Der Neodarwinismus hat an die Stelle eines göttlichen Schöpfers lediglich den Gott Zufall gesetzt, der ebenso allmächtig, allwissend und allgegenwärtig ist. Er kann alles: Er macht unzählige der erstaunlichsten Erfindungen. Er weiß alles: Er beherrscht souverän alle biochemischen, biophysikalischen und biologischen Gesetze und stellt alle wissenschaftlichen Leistungen auf diesen Gebieten weit in den Schatten. Er ist überall in Aktion und ist doch unsichtbar - unsichtbar und unfassbar im wahrsten Sinne des Wortes. Sogar seine Herkunft gleicht der eines Gottes: Auch er ist unsterblich und war schon immer da." PROF. FERDINAND SCHMIDT: GOTT ZUFALL. BIOLOGIE HEUTE August 1989, p. 3.

16. **C. R. S.**:

"Whatever form the gall takes, the potentialities of the tissue-growth exhibited by it, must be present at the spot pricked by the fly. It is not necessary to assume, with De Vries, that every vegetable cell contains the potentialities of every other cell in a latent condition. The conical growing point in every bud contains the germ-plasm of the next shoot, and consequently of the whole plant."

W.-E. L.:

"Whatever form the gall takes, the potentialities of the tissue-growth exhibited by it, must be present at the spot pricked by the fly." Excactly! Leading us to the question, how these special gall producing potentialities came about?

17. **C. R. S.**:

"…The potentialities of growth being present, they are called into activity by the larva, a result advantageous to the larva and sometimes described as disinterested and self-sacrificing on the part of the plant [quoting in a footnote Mivart]. We have just seen that, so far as the larva is concerned, the peculiar structures of the gall owe their origin to their success in feeding and defending it;…"

W.-E. L.:

Just the general potentialities of plant growth? How, then, did all the new gall tissues and novel plant organs originate? So, nothing really explained! He simply assumes in an act of Darwinian faith that "the potentialities of growth being present" have been arisen due to omnipotent natural selection of 'infinitesimal improvements' for "gradually increasing complexity" – without telling us why, how and when all the assumed thousands of gradual steps (multiplied with the number of independently arisen gall inductions in time and space) genetically originated and despite the fact that natural selection is unable to cope with the infinitesimally small steps envisioned by him in the wake of Darwin's theory and nowadays preached by the ruling contemporary neo-Darwinians.

18. **C. R. S.**:

"…and so far as the plant is concerned, these structures have been evolved in consequence of their value in enabling the plant to repair injuries in general, and the injuries inflicted by larvae in particular."

W.-E. L.:

Concerning his statement that "…these structures have been evolved in consequence of their value in enabling the plant to repair injuries in general, and the injuries inflicted by larvae in particular" my question is: Could that really not have been accomplished/achieved/attained and realized much simpler, easier and uncomplicated, as well as straight forward instead of producing, among many other structures, "***new organs***", "***highly specialized plant organs***", "***unique organs***", "***de novo plant tissue or organ***", "***neoformed plant organs***", "***ectopic organ***" and ***entirely new generation of forms***? (See above.) And all these structures just to "repair injuries in general, and the injuries inflicted by larvae in particular"?

Erich Becher: has addressed this question as follows: "It has been said repeatedly [see the series of eminent entomologists cited above under point (7) of the definitions] that gall formation means an attempt by the host plant to encapsulate the parasite and remove it from its own body. We find the encapsulation of foreign bodies and parasites as a protective measure in plants, animals and humans (e.g. in tuberculosis). However, ***Küster rightly rejects this view, since wound cork – the tissue that "takes over and solves this issue in higher plants - does not play the slightest role in the formation of galls and only appears after the development of the gall inducer in order to reject the gall***". In any case, the attempt at encapsulation would hardly appear to be a self-serving feat, since it grants the enemy food, shelter and protection, in order to release it when its well-being requires it. This encapsulation certainly amounts to promoting the parasite and thus to self-harm and harm the respective plant species. If the gall imprisoned its inhabitant for extermination, for example for starvation, or removed it from the plant prematurely through the formation of cork, then the matter would be quite different for the selectionist explanation."[160]

19. **C. R. S.**:

"If John Doe raises a cane to strike Richard Roe, and Richard throws up his arms intuitively to parry the stroke, the action does not indicate a prophetic arrangement of molecules to frustrate John in particular, but an inherited action of defence."

W.-E. L.:

Charles R. Straton is indefatigably missing the key points of the argument for plant altruism involved in gall formation. So what would John Doe say if Richard Roe – after throwing up his arms – produced entirely new "organs" (say growing an impenetrable new shield, a two-edged

[160]Original German text of Becher: "Man hat etwa wiederholt gemeint, die Gallbildung bedeute einen Versuch der Wirtspflanze, den Parasiten einzukapseln und aus dem eigenen Leibe zu entfernen; Einkapselung von Fremdkörpern und Parasiten finden wir als Schutzmaßnahme bei Pflanze, Tier und Mensch (z.B. bei der Tuberkulose). Doch lehnt Küster die Ansicht wohl mit Recht ab, da Wundkork – das Gewebe das bei „höheren Pflanzen jene Ausgabe übernimmt und löst – bei der Gallenbildung nicht die geringste Rolle spielt und höchstens erst n a c h der Entwicklung des Gallenerzeugers auftritt, um die Galle abzustoßen" . Jedenfalls würde der Einkapselungsversuch kaum als selbstdienlich-zweckdienlich erscheinen, da er dem Feind Nahrung, Obdach und Schutz gewährt, um ihn dann freizulassen, wenn sein Wohl dies erfordert, diese Einkapselung läuft durchaus auf Förderung des Schädlings und somit auf Selbst- und Artschädigung hinaus. Wenn die Galle ihren Bewohner zur Vernichtung, etwa zum Verhungern, einkerkerte oder ihn frühzeitig durch Wundkorkbildung aus der Pflanze entfernte, so läge die Sache für die selektionistische Erklärung ganz anders."

sword and a modern machine gun at that) ***and then gave all these weapons of defense to John Doe who would – in the most extreme case – use them to kill Richard*** (Cecidiosis, see examples above and in *Part I* of *Plant Galls and Evolution*).

20. **C. R. S.**:

"The first act of an injured plant is to throw out a blastem, and only those larvae survive to hand down their art, which emerge from an egg so cunningly placed as to excite the growth of a nutritive blastem."

W.-E. L.:

Darwinism has survived the more than 150 years up to now ***by the art of taking everything for granted, which really has to be explained scientifically***.

"…an egg so cunningly placed as to excite the growth of a nutritive blastem." Well, what is a blastem? "A blastema (Greek βλάστημα, "offspring" is a mass of cells capable of growth and regeneration into organs or body parts. ***Historically, blastemas were thought to be composed of undifferentiated pluripotent cells***, but recent research indicates that in some organisms blastemas may retain memory of tissue origin. Blastemas are typically found in the early stages of an organism's development such as in embryos, and in the regeneration of tissues, organs and bone."[161] "Sometimes the gall causer induces older cells to de-differentiate, to lose characteristics they have already developed and to revert to a more juvenile state. They then can develop new tissues that benefit the galler."[162]

Well, this is often done with anatomical precision – reminding perhaps of the instances analyzed by Fabre – when, for example the phloem is exactly aimed at (Strugger), but in other cases almost the whole leaf area is affected (*cf*. example of the galls of *Aceria cephalonea* (mite) on *Acer campeste* above). "…cunningly placed…", i.e. from accidentally placed at the beginning to eventually "cunningly" reaching the phloem?

21. **C. R. S.**:

"It is not always possible to keep the besiegers from using the waters of the moat, although there is no disinterested thought of the besiegers' wants when the ditches are planned."

W.-E. L.:

Well, in gall formation the situation is almost totally different. To complete that humanized/anthropomorphized illustration of Charles R. Straton would imply that the besieged [due to the persuasiveness of the invaders] are providing not only the water (directly in especially build vessels for and to them), but also the best supplies available, accommodation and even weapons of defence and attack at that – i.e. in one word: everything the besiegers need to come off victoriously and even continues their warfare on the affected plant species permanently *ad infinitum*.

Recall in this context that "the gallers the plants usually provide optimal nutrition (feed and house the larvae), administer excellent microenvironments, enemy escape, produce safe and comfortable homes protecting their hosts" … "To sum up: For insects, for example, the plants provide an unsurpassed five-star luxury hotel for free for the entire larval development" ((*cf*. http://www.weloennig.de/PlantGalls.pdf).

22. **C. R. S.**:

"So in the wargame that goes on between insect and plant, natural selection directs the moves of both players, but there is nothing generous or altruistic on either side."

W.-E. L.:

That's the Darwinian heritage of an imbalanced and wholly one-sided worldview of "Nature red in tooth and claw", the "fight of all against all", all living beings in infinite competition with each, – a naturalistic worldview in which cooperation, compassion, peace, patience, goodness, mildness, not to speak of altruism, has absolutely no place, where "there is nothing generous or altruistic on either side" and never can and will be[163]. For nature *cf*. Dawkins' *The Selfish Gene* (except for some doubtful qualifications in man) and in contrast to Dawkins, see the comments of Walter James ReMine's on "altruistic traits" in his book *The Biotic Message*. St. Paul Science. Saint Paul, Minnesota.

Scientifically speaking, I would categorize the explanations of Charles R. Straton as mostly simplistic evolutionary speculations, in which all the essential points on *plant galls and evolution* are either presupposed as being already solved or entirely missing, where natural selection is omnipotent and at the same time to an astonishing degree humanized/anthropomorphized and, as the second pillar of the theory, variation is without limits ("I can see no limit to the amount of change … in the long course of time by nature's power of selection, that is by the survival of the fittest …" Darwin) – see further details in http://www.weloennig.de/OmnipotentImpotentNaturalSelection.

---

161 https://en.wikipedia.org/wiki/Blastema

162 Redfern, Margaret. Plant Galls (Collins New Naturalist Library, Book 117). HarperCollins Publishers. Kindle-Version.

163 Wenn auch immer wieder bestritten worden ist, daß Darwin und seine Nachfolger den "Kampf ums Dasein" in dieser Weise verstanden (so z. B. von Erben 1975, p.178, auch in seinen Vorlesungen 1979), so kann uns doch ein Blick ins 3. Kapitel der ORIGIN-Arbeit und in Haeckels Werke von der Richtigkeit des Clarkschen Ansatzes überzeugen.

Haeckel zum Beispiel spricht (1911, pp. 17/18) von einem "schonungslosen höchst erbitterten Kampf aller gegen alle", und findet "überall Kampf, Streben nach Selbsterhaltung, nach Vernichtung der direkten Gegner und nach Vernichtung des Nächsten...Darwin hat gerade dieses sehr wichtige Verhältnis in seiner hohen und allgemeinen Bedeutung uns erst recht klar vor Augen gestellt, und derjenige Abschnitt seiner Lehre, welchen er selbst den "Kampf ums Dasein" nennt, ist einer ihrer wichtigsten Teile." (Von Haeckel gesperrt.)

Als Beispiele für Darwins Verständnis des Kampfes ums Dasein und der Selektion können schon die Titel der Unterkapitel von Chapter III der Origin-Arbeit dienen: "Competition universal" und "Struggle for life most severe between individuals and varieties of the same species (und im Inhaltsverzeichnis): often severe between species of the same genus." Textbeispiel: "Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with the other of the same species, or with the individuals of distinct species, or with the physical conditions of life." Nach etwa fünf Seiten Ausführungen faßt Darwin zusammen:"In looking at nature, it is most necessary to keep the foregoing considerations in mind - never to forget that every single organic being may be said to be striving to the utmost to increase in numbers; that each lives by a struggle at some period of its life; that heavy destruction inevitably falls either on the young or old, during each generation or at recurrent intervals" (Darwin, pp. 68, 71 - man vgl. den Text im Zusammenhang, um zu ermessen, ob Haeckel seinen Meister auch tatsächlich richtig verstanden hat.)

See more at http://www.weloennig.de/mendel05.htm

Now: What about intelligent design?

According to my experiences in many discussions not only the public but also most scientists show a very inadequate understanding (to put it mildly) of the intelligent design theory. A widely spread common misconception is, for example, that ID theorists attribute “everything” which cannot be explained by the modern synthesis (=neo-Darwinism) to direct interventions by a designer. However, to explain a certain phenomenon, basic questions about natural law and chance are asked first.

As a good start, let's take a closer look at the methodology of ID theorist William Dembski's Explanatory Filter (*cf.* also my article http://www.weloennig.de/KutscheraPortner.pdf):

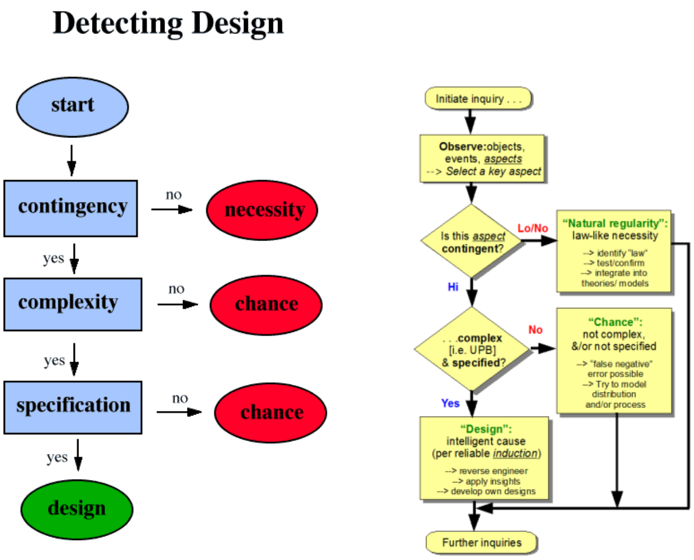


Figure on the left: http://www.unm.edu/~hdelaney/filter.html and on the right: https://uncommondescent.com/computing-ai-cybernetics-and-mechatronics/a-note-on-state-space-search-challenge/

When researching a natural phenomenon, the ID theorist now proceeds as follows (for the use of the term contingency, see the footnote[164]) - the methodology of the filter is explained very well in the following paragraphs:

> ”The filter first asks whether a given pattern is best explained by some **chemical or physical necessity or law**? If not, can it be explained by **chance**. If chance and necessity can’t explain the pattern, does it exhibit a “**specification**” or apparent **purpose**? If a complex pattern reflecting the integration of numerous stopping points does exhibit purpose and can’t be explained by chance or necessity, then the scientific, logical inference to the best explanation is design. The steps in this process of elimination can be taken in any order. The question of whether life is or is not designed focuses on ruling out chance and necessity because most biologists acknowledge that living systems appear to be designed for a purpose. They simply claim that the appearance of design is just an illusion that can be explained by chemical and biological evolution, processes driven solely by unintelligent material causes alone. So, the question ultimately becomes whether those unintelligent causes are adequate to that task.
>
> The explanatory filter can be explained using a death investigation by a coroner as **an example**. Suppose a 98 year old male has been found dead in his bed by the next door neighbor who noticed a noxious smell. The coroner’s check list contains three possibilities: “natural cause” consisting of disease or physical necessity like a heart attack, “accidental cause” like the taking of too many pills from the wrong bottle, or “intentional cause,” like a homicide or suicide. He can also report: there is no “best explanation,” – the data or “clues” are not sufficient to implicate any of the three possibilities. If the coroner finds a **knife** in the back of the body he may do an autopsy to determine whether death resulted from that stab wound or from an earlier cause with the knife being placed after death to confuse the investigation. If the knife wound caused the death, then it will likely be deemed a “smoking gun” that rules in design and rules out natural or accidental death.

Explanatory Filter Step 1 – Ruling Necessity In or Out

> Step one of the explanatory filter asks if some physical or chemical necessity explains the apparent design of a natural object. Consider, for example, a snowflake or salt crystal. Is a snowflake or a salt crystal a design or an occurrence? That is, can a snowflake or salt crystal be explained as being a necessity constrained by known, immutable laws of physics? The answer is yes. Taking a

[164] „Das Wort Kontingenz mit dem Adjektiv kontingent (griechisch τὰ ἐνδεχόμενα endechómena „etwas, was möglich ist“; mittellateinisch contingentia, „Möglichkeit, Zufall“) ist ein philosophischer Terminus, der u. a. in der Modallogik und Ontologie gebraucht wird. „Kontingent“ bezeichnet den Status von Tatsachen, deren Bestehen gegeben und weder notwendig noch unmöglich ist.“ https://de.wikipedia.org/wiki/Kontingenz_(Philosophie)
„Die Kontingenztheorie der Evolution ist eine makroevolutionäre Theorie, die besagt, dass das Leben auf der Erde überwiegend von Zufällen (kontingenten Ereignissen) abhängig ist und nicht noch einmal so entstehen würde wie es heute ist.“ https://de.wikipedia.org/wiki/Kontingenztheorie_(Evolution)
"The word contingency with the adjective contingent (Greek τὰ ἐνδεχόμενα endechómena" something that is possible "; Middle Latin contingentia," possibility, chance ") is a philosophical term that u. a. is used in modal logic and ontology. "Contingent" denotes the status of facts, the existence of which is given and neither necessary nor impossible. "Https://de.wikipedia.org/wiki/Kontingenz_(Philosophie)
"The contingency theory of evolution is a macroevolutionary theory that says that life on earth is largely dependent on chance (contingent events) and would not arise again as it is today." Https://de.wikipedia.org / wiki / contingency theory_ (evolution)

snowflake as an example, the physical properties of hydrogen and oxygen ions that form H_2O under certain conditions of temperature and pressure produce intricate hexagonal shapes by known physical laws of thermodynamics. **Accordingly, one need not invoke an intelligence cause to explain a snowflake or salt crysta**l.

However, can physical and chemical necessity explain the particular sequence of genetic symbols of DNA that carry the messages of life? Interestingly, the answer is no. The genetic symbols consisting of nucleotide bases of adenine, guanine, thymine and cytosine (AGTC) can be arranged in any order. **Unlike the chemistry of a snowflake or salt crystal, the physical and chemical properties of the four genetic symbols, like dots and dashes in a Morse code message, can hook into any position along the sugar-phosphate backbone of DNA**. Just as the letters on this page can be ordered in any sequence, the genetic symbols that specify the letters of life can be arranged in any order to communicate a nearly infinite variety of messages. Watson and Crick predicted this peculiar characteristic, for if the structure of DNA were driven by law, it could not carry the information necessary to generate the seemingly infinite variety of life:

So, in building models we would postulate that the sugar-phosphate backbone was very regular, and the order of bases of necessity very irregular. If the base sequences were always the same, all DNA molecules would be identical and there would not exist the variability that must distinguish one gene from another.[5]

Explanatory Filter Step 2 – Ruling Chance In or Out

Taking the second step of the explanatory filter, if necessity can't explain a pattern, such as the patterns in DNA, then perhaps chance can explain it. Perhaps random assortments of chemicals came together to produce the first messages of life, for example. After life got started, maybe random mutations in the initial messages would occasionally generate positive functional novelty that would be embraced by the environment. Is 4 billion years enough time for a chance process to turn rocks into intelligent beings that have the capacity to use them for a purpose?

……….

The answer to this question reveals a key problem with the chance hypothesis. **A sequence that is actually not very long exhausts the universe's available probability resources very quickly**. The reason is that probability decreases exponentially as complexity increases only incrementally. Add two digits to the state lottery and no one would ever win.

The exponential decrease is illustrated by a simple example. Suppose you were to put in a brown bag 26 upper case letters of the alphabet, 26 lower case letters and a period, space and a comma. You now have all the possibilities in the bag necessary to write a coherent book. What would be the likelihood of randomly pulling letters in the sequence necessary to spell the first word of the title of the book, which we will title DESIGN vs. Chance. Lets also assume that each time we pull a letter, we will return it to the bag after noting its occurrence? The chance of pulling the D is 1/55. But to get "DE," the first two letters in the necessary sequence, the chance is 1/55 times 1/55 or 1/3025. To get three letters, DES, the probability is 1/55 x 1/55 x 1/55 = 1/166,375. Four letters, DESI is 1/9,150,625. Five, DESIG is 1/500 million and six, DESIGN is 1/28 billion.

As one can see, **chance may explain short sequences having low complexity**. **However, chance cannot plausibly account for longer and longer sequences where the complexity also exhibits a purpose**. The exponential decrease in probability is a major problem for the explanatory power of any chance mechanism, even with a universe trillions of years old. When one does the calculation one finds that even if every elemental particle in the entire universe was a monkey and all monkeys started banging away at typewriters with 55 keys at the rate of 1045 per second at the beginning of the big bang, they still would not have produced a specific sequence equivalent to the first sentence of Lincoln's Gettysburg Address. Because of the exponential decrease in probability, they would exhaust the available probability resources to get only the first 87 of the 175 letters and spaces that make up the sentence. And **the most simple DNA sequence is 100's of times more complex than the first sentence of the Gettysburg Address**.

The core challenge to evolutionary theory is to explain the chance occurrence of very long sequences of genetic symbols necessary to generate many integrated functional systems that will survive and replicate in the environment that then exists. The challenge is formidable because the genetic sequences necessary to achieve function are extraordinarily long. Instead of spelling the first six letter word comprising the title, material causes must generate an entire novel to get life started.

Explanatory Filter Step 3 – Identifying purpose – Finding a Specification

The third element of Dembski's filter is to look for an apparent "specification" or purpose. According to Dembski, the required "specification" is present if it reflects a meaning, structure or function recognizable by a mind that is independent of the significance of the various elements **that make up the pattern**. For example, the following are two different combinations of six letters of the alphabet: NEDGIS and DESIGN. The first, consisting of NEDGIS, reflects a random ordering of the six letters. It does not reflect any meaning recognizable by a mind that is independent of the significance of each of the symbols that make up the pattern. However, the second sequence that was ordered for a purpose, "DESIGN," has a meaning that is independent of the six letters in the sequence. The "D" in both sequences has the same significance separately, but in one sequence the relative position of the D enables that sequence to "mean," as a verb "to intend for a definite purpose."

In the book by Carl Sagan, **Contact**, a sequence of prime numbers received by a radio telescope from outer space was deemed to be a possible design or message. In the first step of the filter, the peculiar pattern of beeps and pauses could not be explained by any physical or chemical necessity. Further, its length of over 1000 symbols ruled out chance in the second part of the analysis. The investigation then turned to a search for a "specification," a meaning or significance for the sequence of prime numbers that was independent of the symbols themselves. They were looking for something that would tie the over 1000 stopping points to an integrated whole. They asked, what meaning lies in a series of prime numbers? Jody Foster, remarked, "Maybe it is an attention getter!" Sure enough the message alerted the SETI researchers to a subsequent message containing the blue prints for building an extraordinary machine that ultimately transported Ms Foster into another world.

Finding a specification or purpose in living systems is not really an issue. Like the SETI researchers in Contact, modern day biologists are trying to find the function or meaning of long sequences of DNA previously thought to be evolutionary "junk." Parts of DNA clearly code for function or purpose, but what is the meaning of the rest of it? Hence, **most biologists concede that living systems give the appearance of design**. Recently prominent evolutionary biologists in papers published in the Proceedings of the National Academy of Science acknowledged that the "***the challenge for evolutionary biologists is to explain how seemingly well designed features of organism, where the fit of function to biological structure and organization often seems superb, is achieved without a sentient Designer***.'"

DNA consists of coded “messages” that are copied by “messenger RNA.” The copy is taken to a processing plant called a ribosome, which then “translates” the message into a functional three-dimensional part or genetic word called a protein. Thus, like the recipes in cook books, sequences of nucleotide bases in DNA carry meaning that is independent of the significance of each of the symbols that make the “message.” They not only look like specifications, they function as specifications.”[165]

For another test criterium I would like to the reader’s attention to the phenomenon of ***irreducible complexity***. Michael J. Behe definiert: “By irreducible complex I mean a single system composed of several well-matched, interacting parts that contribute to the basic function of the system, wherein the removal of any one of the parts causes the system to effectively cease functioning” (*Darwin's Black Box*, 1996/2006, p. 39). The design theorist therefore first conducts intensive research into whether the above and other criteria apply to a particular phenomenon.

William Dembski himself has repeatedly emphasized that in this method there is “*no magic, no vitalism, no appeal to occult forces*” involviert sind (ebenso Behe). And, indeed: “***Inferring design is widespread, rational, and objectifiable***.” Dembski:

“Hardly a dubious innovation, Intelligent Design formalizes and makes precise ***something we do all the time***. All of us are all the time engaged in a form of rational activity which, without being tendentious, can be described as inferring design. ***Inferring design is a perfectly common and well-accepted human activity***. *People find it important to identify events that are caused through the purposeful, premeditated action of an intelligent agent, and to distinguish such events from events due to either law or chance*. Intelligent Design unpacks the logic of this everyday activity, and applies it to questions in science. **There's no magic, no vitalism, no appeal to occult forces here**. ***Inferring design is widespread, rational, and objectifiable***. The purpose of this paper is to formulate Intelligent Design as a scientific theory.

The key step in formulating Intelligent Design as a scientific theory is to delineate a method for detecting design. Such a method exists, and in fact, we use it implicitly all the time. The method takes the form of a three-stage Explanatory Filter. Given something we think might be designed, we refer it to the filter. If it successfully passes all three stages of the filter, then we are warranted asserting it is designed. ***Roughly speaking the filter asks three questions and in the following order: (1) Does a law explain it? (2) Does chance explain it? (3) Does design explain it?***

See the explanations above. A key point of the methodology is, I would like to emphasize once again (because of its central importance), **specification** - or in Dembski's words:

“…Suppose finally that no law is able to account for the thing in question, and that any plausible probability distribution that might account for it does not render it very likely. Indeed, ***suppose that any plausible probability distribution that might account for it renders it exceedingly unlikely. In this case we bypass the first two stages of the Explanatory Filter and arrive at the third and final stage***. **It needs to be stressed that this third and final stage does not automatically yield design - there is still some work to do**. Vast improbability only purchases design if, in addition, the thing we are trying to explain is **specified**.

The third stage of the Explanatory Filter therefore presents us with a binary choice: attribute the thing we are trying to explain to design if it is specified; otherwise, attribute it to chance. In the first case, the thing we are trying to explain **not only has small probability, but is also specified**. In the other, it has small probability, but is unspecified. It is this category of specified things having small probability that reliably signals design. ***Unspecified things having small probability, on the other hand, are properly attributed to chance***.

The Explanatory Filter faithfully ***represents our ordinary practice of sorting through things we alternately attribute to law, chance, or design***. In particular, the filter describes

[1] how copyright and patent offices identify theft of intellectual property
[2] how insurance companies prevent themselves from getting ripped off
[3] how detectives employ circumstantial evidence to incriminate a guilty party
[4] how forensic scientists are able reliably to place individuals at the scene of a crime
[5] how skeptics debunk the claims of parapsychologists
[6] how scientists identify cases of data falsification
[7] how NASA's SETI program seeks to identify the presence of extraterrestrial life, and
[8] how statisticians and computer scientists distinguish random from non-random strings of digits.

…….

Why the Filter Works

The filter is a criterion for distinguishing intelligent from unintelligent causes. Here I am using the word "criterion" in its strict etymological sense as a method for deciding or judging a question. The Explanatory Filter is a criterion for deciding when something is intelligently caused and when it isn't. Does it decide this question reliably?

As with any criterion, ***we need to make sure that whatever judgments the criterion renders correspond to reality***. A criterion for judging the quality of wines is worthless if it judges the rot-gut consumed by winos superior to a fine French Bordeaux. The reality is that a fine French Bordeaux is superior to the wino's rot-gut, and any criterion for discriminating among wines better indicate as much.

….I argue that the explantory filter is a reliable criterion for detecting design. Alternatively, I argue that the Explanatory Filter successfully avoids false positives. Thus, whenever the Explanatory Filter attributes design, it does so correctly.

Let us now see why this is the case. I offer two arguments. The first is a straightforward inductive argument: in every instance where the Explanatory Filter attributes design, and where the underlying causal story is known, it turns out design actually is present; therefore, design actually is present whenever the Explanatory Filter attributes design.

[165] Man muss nicht politisch konservativ sein, um die folgende Enzyklopädie zu zitieren: https://www.conservapedia.com/Explanatory_filter (abgerufen am 3. März 2019)

> My second argument for showing that the Explanatory Filter is a reliable criterion for detecting design may now be summarized as follows: the Explanatory Filter is a reliable criterion for detecting design ***because it coincides with how we recognize intelligent causation generally***. In general, to recognize intelligent causation we must observe a choice among competing possibilities, note which possibilities were not chosen, and then be able to specify the possibility that was chosen.[166]

Hence, to apply the intelligent design theory to *plant galls and evolution* needs intensive research. Probably the best candidates to be first investigated in this context are presented by the galling insects and their galls.

So, let's take the first step – and I would like to emphasize that the following questions and answers are nothing more than a modest beginning – to apply the test criteria shown above for detecting intelligent design to the plant gall insects and their inducers.

1. **Question**: Is the pattern presented by the insects and their galls possibly best and convincingly explained by some *chemical, physical, or biological law* necessarily generating them?

   Answer: In spite of the formulation of almost infinite evolutionary hypotheses and investigations looking for (or implying) such a law during the last more than 200 years (starting at the latest with Lamarck 1809)[167] by literally thousands of Darwinians and further evolutionary biologists (including all their different evolutionary schools around the globe), **absolutely *no chemical, physical, or biological law* could be detected, which would necessarily produce either insects (in general) or the special insects inducing plant galls**.

   See also *Plant galls and the fossil record* in *Part I* of *Plant Galls and Evolution*[168] as well as the discussion on *Paleontology and the Explosive Origins of Plant and Animal Life A Dialogue with an Evolutionary Geologist on Gradualism and Intelligent Design* http://www.weloennig.de/ExplosiveOrigins.pdf.

2. **Question**: *Does chance* – being at the very foundations of random mutations and natural selection[169] – *best explain the phenomenon of plant galls and their insects*?

   Answer: As we have seen in detail above, ***accidental mutations and natural selection*** (apart from the limits due to the law of recurrent variation, randomness in natural selection, coadaptation/synorganization, irreducible complexity, the abrupt appearance of entire world floras and faunas in the fossil record etc.) ***cannot produce hidden genetic potentials in plant hosts for entirely new structures serving exclusively their guests***.

3. **Question**: *Does design explain* the origin of insects (some 5 million species) including the minority of their forms (ca. 132,930) triggering and building plant galls?

---

[166] William A. Dembski The Explanatory Filter: A three-part filter for understanding how to separate and identify cause from intelligent design An excerpt from a paper presented at the 1996 Mere Creation conference, originally titled "Redesigning Science." http://www.arn.org/docs/dembski/wd_explfilter.htm (17. März 2019).

[167] https://de.wikipedia.org/wiki/Jean-Baptiste_de_Lamarck - just an example: „Wenn in der That irgend eine Affenrace hauptsächlich die vollkommenste derselben, durch die Verhältnisse oder durch irgend eine andere Ursache gezwungen wurde, die Gewohnheit, auf den Bäumen zu klettern und die Zweige mit den Füssen sowohl als mit den Händen zu erfassen, um sich daran aufzuhängen, aufzugeben und wenn die Individuen dieser Race während einer langen Reihe von Generationen gezwungen waren, ihre Füsse nur zum Gehen zu gebrauchen und aufhörten, von den Füssen denselben Gebrauch wie von den Händen zu machen, so ist es nach den im vorigen Kapitel angeführten Bemerkungen nicht zweifelhaft, dass die Vierhänder schliesslich zu Zweihändern umgebildet wurden und dass die Daumen ihrer Füsse, da diese Füsse nur noch zum Gehen dienten, die Entgegenstellbarkeit zu den Fingern verloren. Wenn überdies die Individuen, von denen ich spreche, bewegt durch das Bedürfniss zu herrschen und zugleich weit und breit um sich zu sehen, sich anstrengten, aufrecht zu stehen und an dieser Gewohnheit von Generation zu Generation beständig festhielten, so ist es ferner nicht zweifelhaft, dass ihre Füsse unmerklich eine für die aufrechte Haltung geeignete Bildung erlangten, dass ihre Beine Waden bekamen und dass diese Thiere dann nur mühsam auf den Händen und Füssen zugleich gehen konnten."
Pure evolutionary speculation! Anything can be imagined that way. See the facts against that view http://www.weloennig.de/HumanEvolution.pdf. As for further evolutionists ***before Darwin***, see also Carl Friedrich von Gärtner (1849): http://www.weloennig.de/mendel19.htm

[168] http://www.weloennig.de/PlantGalls.pdf

[169] https://evolutionnews.org/2019/04/listen-paul-nelson-and-wolf-ekkehard-lonnig-on-randomness-in-natural-selection/
https://evolutionnews.org/2016/04/more_on_randomn/

Before starting to answer that question I would like to cheer up the reader to recall and clearly keep in mind the implications of the following points and key words mentioned and discussed above: “hundreds of homologous novel effector proteins”, “intimate biochemical interactions”, the wide range of “services galls provide” exclusively at the expense of the plant hosts producing “entirely new organs”, “good, constant, and definite characters each keeping as true to form as does any independent organic being”, “host specificity” of the gall insects, the example of “535 genes that were differentially expressed” (Narendran et al. 2020), “There was no clear similarity in the global gene expression profiles between the gall tissue and other tissues” “dramatically altered” development (Hirano et. al. 2020), “…26,346 grape transcripts expressed in either gall or leaf or both…11,049 were differentially expressed” (Schultz et al. 2019), intelligence often shows up by the “re-use functional components in different designs”.

Answer: The prerequisite for the inference to intelligent design is: Vast improbability in combination with specification (or in Dembski’s formulation: “Vast improbability only purchases design if, in addition, the thing we are trying to explain is specified”).

Now, concerning the numbers of insect species cited above, virtually every intelligent design theorist distinguishes between micro- and macroevolution (terms induced by Theodosius Dobzhansky in his book *Genetics and the Origin of Species*; for an in depth discussion of the possibilities and limits of evolution by random mutations and natural selection, see, for example, http://www.weloennig.de/Artbegriff.html). The numbers of what I have called “primary species” (“primäre Arten”), more generally known as “kinds”, are often approaching the numbers of genera and families of the plants and animals in question in contrast to the usually enormous numbers presented by the morphological species concept or the species concept of the synthetic theory.

However, the question has to be decided on a case-by-case basis. A comprehensive generalization for all life forms is not possible. A primary species can also largely be identical with a species of modern systematics.

So, the application of the criteria to detect intelligent design here focuses first on the origin of primary species.

Research projects: (a) How many and which are the primary insect species involved in gall building? (b) To what extent can random mutations and natural selection produce differences in the gall building insects and their galls (probably mostly by degenerative and neutral evolution; see, for example Michael J. Behe (2019) on degenerative evolution in general: *Darwin Devolves: The New Science About DNA That Challenges Evolution*). (c) How many and which DNA sequences and RNA transcripts of the plant hosts’ genetic potential for structures and organs, which are definitely not normally generated, are involved in the formation of the novel, highly specialized plant organs called galls? (d) What is the numerical relationship of the co-opted genes (“the portion”) for flower- and fruit-like traits to “the rest” of the genes, which is commonly never expressed in normal plant development? (e) What is the percentage of galls displaying “remarkable flower- and fruit-like traits” compared to those primarily inducing other traits (like ‘pointed horns, elongated onions, spherical marbles, flat sun hats, shiny gold coins, dainty miniature stilt houses’ etc. according to Wolfgang Kuhn).

Nevertheless, considering all the different aspects of plant galls discussed above as well as *Part I* of *Plant Galls and Evolution* one may ask: Is there anything that can already approvingly be said on plant galls and intelligent design? Which criteria identifying intelligent design appear to be fulfilled according to our present biological knowledge?

Vast improbability: fulfilled.
Specification: fulfilled.
Purpose: fulfilled.
Coadaptaion/Synorganization: fulfilled (even between kingdoms, "inter-kingdom").
Irreducible complexity: most probably fulfilled by many examples.
Dormant, usually non-appearing form-building abilities [that] can be awakened in the plant: fulfilled.
Plant 'altruism': fulfilled.
Insects use complex compositions of proteins for gall induction in coordination with or attuned to the potential of gall formation in the affected plants: fulfilled.

Although many research questions are still open, the reader is invited to decide for himself whether he/she can already draw the conclusion to intelligent design for many of the plant gall phenomena.

Back to Internet Library

The following examples according Bellmann, Spohn and Spohn (2018): Faszinierende Pflanzengallen. Quelle & Meyer Verlag Wiebelsheim. German original texts:

(c) *Pterotopteryx dodecadactyla*: "Zweig der Wirtspflanze [*Lonicera xylosteum*] auf 2-3 cm Länge spindelförmig angeschwollen. Im Innern des Zweiges ein Fraßgang mit rötlich gefärbter Schmetterlingsraupe. Diese bohrt vor der Verpuppung einen Ausgang, durch den der schlüpfende Falter später den Zweig verlässt" (p. 203). How did it leave the gall before it had prepared an exit?

(c) *Adelges viridis*: "Im Juni oder Juli öffnet sich die Galle spaltförmig an der Verwachsungsrändern und entlässt die flugfähigen Tiere" (p. 229).

(d) *Paranthrene tabaniformis*: "…vor dem Schlupf des Falters schiebt sich die Puppe durch ein zuvor von der Raupe genagtes Schlupfloch nach außen…" (p. 258).

(e) *Andricus foecundatrix*: "….öffnet sich nach Art einer Rosenblüte.." (p. 288).

(f) *A. quercuscorticis*: "…Gallendeckel trocknet im Herbst und fällt ab…" (p. 304).

(g) *Andricus quercustozae*: "…Bei der Reife im Oktober oder November schieben sie [die Gallen] sich immer weiter aus der Knospe hervor, um schließlich zu Boden zu fallen. Die Larve verpuppt sich in der Galle am Boden" p. 307). Baumwollgalle.

(h) *Andricus testceipes*:"...die Wespen …verbringen aber den Winter in der Galle, bevor sie diese im Februar oder März des 3. Jahres durch ein Loch auf der Seite verlassen" (parthenogenetische Generation p. 311).

(i) *Cynips quercusfolii*:"Die Wespe schlüpft oft bereits im Oktober aus der Puppe, und nagt zunächst einen Schlüpfgang bis dicht unter die Gallenoberfläche. Zwischen November und März verlässt sie dann bei günstiger Witterung ihr Quartier, um ihre Eier in Knospen abzulegen" (p. 322).

(j) *Didymomyia tiliacea*: "Färbung in der Mitte grün, am Rand oft leuchtend rot. Schließlich grenzt sich an der weiter aufragenden Seite der mittlere Teil durch eine Ringfurche ab, färbt sich braun (**B**) und schiebt sich nach und nach immer weiter wie ein Korken in die Höhe (**C**), bis er sich ganz losköst und zu Boden fällt. In dieser korkenartigen Innengalle befindet sich die weißliche oder hellgelbe Larve, die sich schließlich am Erdboden verpuppt. Nach dem Abfallen der Innengalle verbleibt am Blatt der ausgehöhlte Rest der Galle (**A**, Bildmitte unten)" (p. 419). See corresponding Figures in the book).