

Horizontaler Gentransfer

Bei Prokaryonten (Bakterien und Archäen) ist der horizontale Gentransfer die Regel, sozusagen das Tagesgeschäft.

Bei Eukaryonten (den zellkernhaltigen Lebewesen; Pflanzen, Tieren, Pilzen) ist der horizontale Gentransfer in der Regel nur unter erschwerten Bedingungen (z.B. Genbeschuss) möglich. Die dadurch entstandenen Chimären sind in der Regel weniger stabil. Sie sind weniger lebensfähig als das Original. Mehrere Ausnahmen aber sind bekannt: der horizontale Gentransfer bei Fadenwürmern, bei Tauflieden, bei einer Art von Rädertieren und im Zusammenhang mit Pflanzen, Tieren und Pilzen. Im Medizinbetrieb werden entsprechende Ereignisse umschrieben mit: Memory Zellen, Autoimmun-Krankheiten, Tumore, [Krebsstammzellen](#) und eventuell auch mit phosphorylierten Tau Proteinen.

Makroskopisch führt ein horizontaler Gentransfer bei Eukaryonten in der Regel zu einer Störung des Zusammenhalts, zu Kohärenz-Problemen, zu Entzündungsreaktionen, zu Krankheit und zur Aktivierung von Reparaturmechanismen, im günstigsten Fall zu einem neuen Gleichgewicht (einer neuen Insel der Ruhe), zu Veränderungen im physischen und psychischen Gleichgewicht, im günstigsten Fall z.B. in dem erhofften Effekt bei aktiven Impfungen zu einer neuen Immunitätslage.

Einer der zahlreichen Ordnungsmechanismen ist der [Methylzyklus](#). Der Methylzyklus schaltet Fremd-Gene stumm.

In prokaryotes (bacteria and archaea) horizontal gene transfer is the rule, so to speak, the daily business.

In eukaryotes (the nucleated beings; plants, animals, fungi) horizontal gene transfer regularly is possible usually under difficult conditions only (e.g. gene-bombardment). The resulting chimeras are in generally less stable. They are less viable than their original. At least three suspected exceptions are still known: the horizontal gene transfer in nematodes, fruit flies, in a species of rotifers and seen only in connection with eukaryotes. Medically such events are denoted by the following transcriptions: memory cells, autoimmune diseases, tumors, [cancer stem cells](#) and possibly with phosphorylated tau proteins also.

Macroscopically, horizontal gene transfer usually leads in eukaryotes to a disruption of cohesion, coherence problems, inflammatory reactions, resulting to disease and activation of repair mechanisms and, at best, to a new equilibrium („island of calm“) with changes in the physical and mental behaviors, to immunity, for example in an active vaccination to the hoped immunization.

One of the numerous mechanisms of discipline is the methyl cycle. The [methyl cycle](#) switches foreign genes silent.

Sonea S (1983), Zinder ND (1992, 1952), Hoffmann T (1994), Lorenz MG (1994), Mitten D (1996), Clerc S (1998), Dröge M (1998), Nielsen KM (1998), Bertolla F (1999), Smalla K (2x2000), Ochman H (2000), Koonin EV (2001), Salzberg SL (2001), Bushman F (2002), Margulis L (2002, 2003), Van Elsas JD (2003), Munksgaard L (2004), Qiu W-G (2004), Hartmann A (2004/2005), MacDonald AB (2006), Sridhar Rao PN (2006), Choi CQ (2007), Dunning Hotopp JC (2007, 2011), Ho M-W (2008), Pudztai A (2009), McGinty S (2011), Schröder G (2011), Anderson MT (2011), Leister D (2011), Guinane CM (2011), Sinkovics JG (2011), Das Biotechnologie und Life Sciences Portal Baden-Württemberg. (2012), Moran Y (2012), Yue J (2012), Robinson KM (2013, 2014), Riley DR (2013), Boto L (2014), Mayoral J (2014), Crisp A et al. (2015), Chrostek E (2017)

McFall-Ngai M, Hadfield MG, Bosch TC et al. (2013) Animals in a bacterial world, a new imperative for the life sciences. PNAS 110(9), 3229-3236 <http://www.pnas.org/content/110/9/3229.full>
<http://www.bosch.zoologie.uni-kiel.de/wp-content/uploads/2013/05/mcfallngaipnas2013.pdf>
<http://www.ncbi.nlm.nih.gov/pubmed/23391737>

Griffith F (1928) **The significance of pneumococcal types.** J. Hyg. 27, 113-159
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2167760/>

Klinenberg E (1935) The natural occurrence of pleuropneumonia like organisms in apparent **symbiosis** with streptobacillus moniliformis and other bacteria. J. Pathol. Bacteriol.40. 485-496.

Commoner B (1965) Biochemical, biological and atmospheric **evolution.** Proc Natl Acad Sci USA. 53(6), 1183-1194.

Sonea S, Panisset M (1983) **A New Bacteriology.** Jones and Barlett Publishers, Inc. Boston ISBN 0-86720-024-3

Commoner B (1984) Relationship between biological information and the origin of life. In: Matsuno K, Dose K, Harada K, et al. eds. Molecular Evolution and Protobiology, p283, Plenum Press. New York.

Zinder ND, Lederberg J (1992, 1952) Genetic Exchange in Salmonella. J Bacteriol 64, 679-699 in Forty Years ago: The Discovery of Bacterial Transduction. Perspectives, The Genetic Society of America. 132, 291-294 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC169409/>

Rijlaarsdam JU, Van der Putte SCJ, Berti E et al. (1993) Cutaneous Immunocytomas: A Clinicopathological Study of 26 Cases. Histopathology, 23, 117-125. <http://dx.doi.org/10.1111/j.1365-2559.1993.tb00469.x>

Hoffmann T, Golz C, Schieder, O (1994) Foreign DNA sequences are received by a wild type strain of Aspergillus niger after co-culture with transgenic higher plants Current Genetics 27, 70-76

Lorenz MG, Wackernagel W (1994) Bacterial gene transfer by natural genetic transformation in the environment. Microbiological Reviews 58, 563-602

Mitten D, Redenbaugh K, Lindemann J (1996) Evaluation of potential gene transfer from transgenic plants, transgenic organisms and biosafety. In: Horizontal gene transfer, stability of DNA and expression of transgenes. Eds.: Schmidt, E.R., Hankeln, T. pp.95-100, Springer Heidelberg

Clerc S, Simonet P (1998) A review of available systems to investigate transfer of DNA to indigenous soil bacteria. Antonie van Leeuwenhoek 73, 15-23

Dröge M, Pühler A, Selbitschka W (1998) Horizontal gene transfer as a biosafety issue: A natural phenomenon of public concern. Journal of Biotechnology 64, 75-90

Nielsen KM, Bones AM, Smalla K, van Elsas JD (1998) Horizontal gene transfer from transgenic plants to terrestrial bacteria – a rare event? FEMS Microbiology Reviews 22, 79-103

Schubert R et al. (1998) On the fate of orally ingested foreign DNA in mice: chromosomal association and placental transmission in the fetus. In: Molecular and General Genetics 259, 569-576

Ho MW et al. (1999) Cauliflower Mosaic Viral promoter: A recipe for disaster. In: Microbial Ecology in Health and Disease. 11, 194-197

Bertolla F, Simonet P (1999) Horizontal gene transfers in the environment: natural transformation as a putative process for gene transfers between transgenic plants and microorganisms. Research Microbiology 150, 375-384

Mercer DK et al. (1999) Fate of free DNA and transformation of oral bacterium Streptococcus gordonii DL1 plasmid DNA in human saliva. In Applied and Environmental Microbiol. 65, 6-10.

Smalla K, Osborn M, Wellington EMH. (2000) Isolation and characterisation of plasmids from bacteria. In Thomas CM (Hg.) The horizontal gene pool - bacterial plasmids and gene spread. Harwood academic publishers. S. 207-248.

Smalla K, Krögerrecklenfort E, Heuer H et al. (2000) PCR-based detection of mobile genetic elements in total community DNA. *Microbiology* 146:1256-1257.

Smalla K, Heuer H, Götz A, Niemeyer D, Krögerrecklenfort E, Tietze E. (2000). Exogenous isolation of antibiotic resistance plasmids from piggery manure slurries reveals a high prevalence and diversity of IncQ-like plasmids. *Appl. Environ. Microbiol.* 66:4854-4862

Ochman H, Lawrence JG, Groisman EA (2000) [Lateral gene transfer and the nature of bacterial innovation](#). *NATURE*. 405.
http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Ochman2000_Lateral_transfer_bacterial_DNA.pdf

Koonin EV, Makarova KS, Aravind L (2001) Horizontal Gene Transfer in Prokaryotes: Quantification and Classification. *Annu. Rev. Microbiol.* 55, 709 – 42. <http://www.ncbi.nlm.nih.gov/books/NBK2228/>

Kunik T, Tzfira T, KapuJnik Y, Gafui Y, Dingwall C, Citovsky V (2001) **Genetic transformation of HeLa Cells by Agrobacterium**. *Proceedings of the National Academy of Sciences*, 98, 1871-76

Salzberg SL et al. (2001) **Microbial genes in the human genome: Lateral transfer or gene loss?** *Science*, 292, 1903-06.

Bushman F (2002) **Lateral DNA Transfer** mechanisms and Consequences. Cold Spring Harbor Laboratory Press, cold Spring Harbor, New York.

Commoner B. (2002) Unravelling the DNA myth: The spurious foundation of genetic engineering. In Harper's Magazine. <http://www.mindfully.org/GE/GE4/DNA-Myth-CommonerFeb02.htm>

Kay E, Vogel TM, Bertolla F, Nalin R, Simonet P. (2002) In situ transfer of antibiotic resistance genes from transgenic (transplastomic) tobacco plants to bacteria. *Applied and Environmental Microbiology* 68, 3345-3351

Margulis L, Sagan D (2002, 2003) **Acquiring Genomes: A Theory of the Origins of Species**, Perseus Books Group,

Van Elsas JD, Turner S, Bailey MJ. (2003) Horizontal gene transfer in the phytosphere. *New Phytologist* 17, 525-537

De Vries J, Heine M, Harms K, Wackernagel W. (2003) Spread of recombinant DNA by roots and pollen of transgenic potato plants, identified by highly specific biomonitoring using natural transformation of an *Acinetobacter* sp. *Applied and Environmental Microbiology* 69, 445-4462

Munksgaard L, Obitz ER, Goodlad JR et al. (2004) **Demonstration of B. burgdorferi-DNA in Two Cases of Nod-al Lymphoma. Leukemia & Lymphoma**, 45, 1721-1723.
<http://dx.doi.org/10.1080/10428190410001683723>

Qiu W-G, Schutzer SE, Bruno JF (2004) **Genetic exchange and plasmid transfers in Borrelia burgdorferi sensu stricto revealed by three-way genome comparisons and multilocus sequence typing**. *Proc Natl Acad Sci U S A*. 101(39), 14150-5. <http://www.ncbi.nlm.nih.gov/pubmed/15375210>
http://www.pnas.org/content/101/39/14150.full?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=borrelia&searchid=1096492260484_7703&stored_search=&FIRSTINDEX=0&volume=101&issue=39

Hartmann A (2004/2005) **Horizontaler Gentransfer, ein natürlicher Prozess**. *mensch+umwelt spezial* 17. Ausgabe
http://www.helmholtz-muenchen.de/fileadmin/GSF/pdf/publikationen/mensch_und_umwelt_spezial/Heft17/59_64_Hartmann.pdf
„Unter natürlichen Bedingungen ist jedoch der horizontale Gentransfer und die Etablierung von Genen in fremden Organismen im Allgemeinen als praktisch vernachlässigbar einzuschätzen.“

- Bushman F, Lewinski M, Ciuffi A et al. (2005) **Genome-wide Analysis of Retroviral DNA Integration**, Nature Reviews Microbiology, 3, 848-58
- Chaconas G (2005) Hairpin telomeres and **genome plasticity in Borrelia**: all mixed up in the end, Molecular Microbiology 58(3), 625-635
- Volff JN. (2006) **Turning junk into gold**: domestication of transposable elements and the creation of new genes in eukaryotes. BioEssays 28(9), 913-22 <http://onlinelibrary.wiley.com/doi/10.1002/bies.20452/pdf>
- MacDonald AB (2006) **Transfection “Junk” DNA—A link to the pathogenesis of Alzheimer’s disease?** Medical Hypotheses 66(6) 1140-1141
- Sridhar Rao PN (2006) [Article on mechanisms of DNA Transfer.](http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Lateral_DNA_transfer_By_Dr_Rao_PDF.pdf)
http://alzheimerborreliosis.net/wp-content/uploads/2012/10/Lateral_DNA_transfer_By_Dr_Rao_PDF.pdf
- [Sherer NM](#), [Lehmann MJ](#), [Jimenez-Soto LF](#), [Horensavitz C](#), [Pypaert M](#), [Mothes W](#) (2007) **Retroviruses** can establish **filopodial bridges** for efficient cell-to-cell transmission. [Nat Cell Biol.](#) 2007 March; 9(3): 310–315. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2628976/>
- Choi CQ (2007) **Bacterial genes jump to host. Frequent lateral gene transfer from bacteria to their host organisms may be a mechanism for hosts' evolution.** The Scientist – Magazine of the Life Sciences. <http://classic.the-scientist.com/news/display/53552/#ixzz1CMT0DtIz>
- Dunning Hotopp JC et al. (2007) **Widespread Lateral Gene Transfer from Intracellular Bacteria to Multicellular Eukaryotes.** Read more: Bacterial genes jump to host - The Scientist - Magazine of the Life Sciences <http://classic.the-scientist.com/news/display/53552/#ixzz1CMQmPXcy>
- Schöllkopf C, Melbye M, Munksgaard L, Smedby KE, Rostgaard K, Glimelius B, Chang ET, Roos G, Hansen M, Adami H, Hjalgrim H (2008) **Borrelia Infection and Risk of Non-Hodgkin Lymphoma.** Blood, 111, 5524-5529. <http://dx.doi.org/10.1182/blood-2007-08-109611>
- Ho M-W, Cummins J. (2008) Horizontal Gene Transfer from GMOs Does Happen, ISIS, <http://www.i-sis.org.uk/horizontalGeneTransfer.php>
- Huang J, Gogarten JP (2009) Ancient gene transfer as a tool in phylogenetic reconstruction. Methods Mol Biol 127-39. [Abstract](#)
- Pudztai A, Bardocz S (2009) **Sicherheitsrisiko Gentechnik.** orange press. ISBN: 987-3-986086-50-8
- Dawkins R (2010) Die Schöpfungslüge. Warum Darwin recht hat. Ullstein. S. 338-342
- Tsuchida T, Koga R, Horikawa M. et al. (2010) Symbiotic Bacterium Modifies Aphid Body Color Science: 1102-1104. [Abstract](#)
- McGinty S, Rankin DJ, Brown SP. (2011) Horizontal gene transfer and the **evolution of bacterial cooperation.** Evolution 65, 21-32. <http://onlinelibrary.wiley.com/doi/10.1111/j.1558-5646.2010.01121.x/full>
- Anderson MT, Seifert HS. (2011) Opportunity and means: **horizontal gene transfer from the human host to a bacterial pathogen.** MBio 2(1), e00005-11. [Abstract](#)
- Leister D, Kleine T (2011) Role of intercompartmental DNA transfer in producing genetic diversity. Int Rev Cell Mol Biol 2011,73-114. [Abstract](#)
- Carattoli A. (2011) Plasmids in Gram negatives: molecular typing of resistance plasmids. Int J Med Microbiol 301(8), 654-8. [Abstract](#)
- Guinane CM, Penadés JR, Fitzgerald JR (2011) The role of horizontal gene transfer in Staphylococcus aureus host adaptation. Virulence 2(3), 241-3. [Abstract](#)
- Sinkovics JG (2011) **Horizontal gene transfers with or without cell fusions in all categories of the living matter.** Adv Exp Med Biol 5-89. [Abstract](#)

Treangen, T.J. et al., (2011) Horizontal Transfer, Not Duplication, Drives the Expansion of Protein Families in Prokaryotes. PLoS Genetics, 7, e1101284
<http://classic.the-scientist.com/news/display/57962/#ixzz1CMPjfMrj>

Dunning Hotopp JC (2011) **Horizontal gene transfer between bacteria and animals**. Trends Genet 27(4),157-63. [Abstract](#)

[Schröder G](#), [Schuelein R](#), [Quebatte M](#), [Dehio C](#). (2011) **Conjugative DNA transfer into human cells by the VirB/VirD4 type IV secretion system of the bacterial pathogen Bartonella henselae**. [Proc Natl Acad Sci U S A](#). 108(35), 14643-8. doi: 10.1073/pnas.1019074108. doi:10.1073/pnas.1019074108. PMID 21844337. PMC 3167556
microbewiki.kenyon.edu/index.php/Bartonella_henselae
<http://www.pnas.org/content/108/35/14643>

Das Biotechnologie und Life Sciences Portal Baden-Württemberg. (2012) **Horizontaler Gentransfer bei Endosymbiosen**. <http://www.bio-pro.de/magazin/index.html?lang=de&artikelid=/artikel/07887/index.html>

Altincicek B., Kovacs JL, Gerardo NM. (2012) Horizontally transferred fungal carotenoid genes in the two-spotted spider mite Tetranychus urticae Biol Lett 253-257. [Abstract](#)

Moran Y, Fredman D, Szczesny P. et al. (2012) Recurrent **Horizontal Transfer of Bacterial Toxin Genes to Eukaryotes** Mol Biol Evol 4 mss089v2-mss089.
<http://mbe.oxfordjournals.org/content/early/2012/04/04/molbev.mss089.full.pdf+html>

Li M, et al. (2012) MRSA epidemic linked to a quickly spreading colonization and virulence determinant Nat Med. <http://www.nature.com/nm/journal/vaop/ncurrent/full/nm.2692.html>

Raymond B et al. (2012) The dynamics of cooperative bacterial virulence in the field. *Science*, doi:10.1126/science.1218196 <http://www.sciencemag.org/content/337/6090/85.abstract>

Yue J et al. (2012) Wide spread impact of horizontal gene transfer on plant colonization of land. Nature Communications. doi: 10.1038/ncomms2148.

Kean WF, Tocchio S, Kean M, Rainsford KD (2012) The musculoskeletal abnormalities of the Simulauun Iceman ("Ötzi"): Clues to chronic pain and possible treatments. Inflammopharmacology. Springer. Experimental and Therapeutic Studies. ISSN 0925-4692
<http://www.ncbi.nlm.nih.gov/pubmed/23096483>

[Wallau GL](#), [Ortiz MF](#), [Loreto EL](#). (2012) Horizontal transposon transfer in eukarya: detection, bias, and perspectives. PMID: PMC3516303 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3516303/>
<http://www.ncbi.nlm.nih.gov/pubmed/22798449>

Kuraku S, Qiu H, Meyer A (2012) Horizontal transfers of Tc1 elements between teleost fishes and their vertebrate parasites, lampreys. Genome Biology and Evolution August 9, doi:10.1093/gbe/evs069
<http://www.aktuelles.uni-konstanz.de/presseinformationen/2012/123/>

Brisson D, Drecktrah D, Eggers CH, Samuels DS (2012) **Genetics of Borrelia burgdorferi**. Annu Rev Genet. 46, 10.1146/annurev-genet-011112-112140. doi: 10.1146/annurev-genet-011112-112140
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3856702/>

Elmer JJ, Christensen MD, Rege K (2013) Applying Horizontal Gene Transfer Phenomena to Enhance Efficacy of Non-Viral Gene Therapy. Review. Journal of Controlled Release. 03:03 EDT 6th September 2013 | [BioPortfolio](#) <http://www.bioportfolio.com/resources/pmarticle/569974/Applying-Horizontal-Gene-Transfer-Phenomena-to-Enhance-Efficacy-of-Non-Viral-Gene.html>

Robinson KM, Sieber KB, Dunning Hotopp JC (2013) **A Review of Bacteria-Animal Lateral Gene Transfer May Inform Our Understanding of Diseases like Cancer**. PLoS Genet 9(10), e1003877. doi:10.1371/journal.pgen.1003877
<http://www.plosgenetics.org/article/info%3Adoi%2F10.1371%2Fjournal.pgen.1003877>

„Lateral gene transfer (LGT) from bacteria to animals occurs more frequently than was appreciated prior to the advent of genome sequencing. ... In this review, we propose that such non inherited bacterial DNA

integration into chromosomes in human somatic cells could induce mutations leading to cancer or autoimmune diseases in a manner analogous to mobile elements and viral integrations.”

Overballe-Petersen S, Harms K, Orlando LAA et al. (2013) **Bacterial natural transformation by highly fragmented and damaged DNA**. PNAS, DOI: [10.1073/pnas.1315278110](https://doi.org/10.1073/pnas.1315278110)
<http://www.pnas.org/content/early/2013/11/12/1315278110.abstract>
<http://de.scribd.com/doc/185666019/Bacterial-natural-transformation-by-highly-fragmented-and-damaged-DNA>
“Our findings suggest that natural genetic exchange of DNA from dead and even extinct organisms to contemporary bacteria can take place over hundreds of thousands of years. Hence damaged and degraded DNA may be a previous unrecognized driver of bacterial evolution with implications for evolutionary theory.”

Ward B, Osterhout C van (2013) **HybRIDS**: Software for the rapid detection, visualization and dating of recombinant blocks in genome sequence data.
<http://www.norwichresearchpark.com/ourresearch/researchgroups/elsa/software/hybrids.aspx>

Mongodin EF, Casjens SR, Bruno JF et al. (2013) Inter- and intra-specific pan-genomes of **Borrelia burgdorferi sensu lato: genome stability and adaptive radiation**. BMC Genomics 14, 693
doi:10.1186/1471-2164-14-693 <http://www.ncbi.nlm.nih.gov/pubmed/24112474>
<http://www.biomedcentral.com/1471-2164/14/693>
“Yet gene-acquisition rates in *B. burgdorferi* s.l. are among the lowest in bacterial pathogens, resulting in high genome stability and few lineage-specific genes. Genome adaptation of *B. burgdorferi* s.l. is driven predominantly by copy-number and sequence variations of lipoprotein genes. New genomic groups are likely to emerge if the current trend of *B. burgdorferi* s.l. population expansion continues.”

Bruto B, Prigent-Combaret C, Luis P et al. (2013) Horizontal acquisition of Prokaryotic genes for eukaryote functioning and niche adaptation. Evolutionary Biology: Exobiology and evolutionary mechanisms, 165-179, Springer Berlin Heidelberg.
http://elifesciences.org/content/3/e04266?ijkey=a3a1fd1633ab6af566e206162812ab0a4c2482fd&keytype2=tf_ipsecsha#sthash.ivBWcUuK.dpuf

Riley DR et al. (2013) **Bacteria-human somatic cell lateral gene transfer is enriched in cancer samples**. PLOS Comput Biol, 9, e1003107.

Martone R, Jensen J (2013) **Untersuchung der Tau - Phosphorylierung als potenzieller Biomarker der Alzheimerkrankheit**.
<https://de.covance.com/sdblog/2013/11/tau-phosphorylation.html>

Robinson KM, Dunning Hotopp JC (2014) **Mobile elements and viral integrations prompt considerations for bacterial DNA integration as a novel carcinogen**. Cancer Lett, 352, 137-44.

Metcalf JA, Funkhouser-Jones LJ, Brileya K et al. (2014) **Antibacterial gene transfer across the tree of life**. Vanderbilt University, United States; Portland State University, United States. DOI:
<http://dx.doi.org/10.7554/eLife.04266> Cite as eLife 3:e04266.
http://elifesciences.org/content/3/e04266?ijkey=a3a1fd1633ab6af566e206162812ab0a4c2482fd&keytype2=tf_ipsecsha#sthash.ivBWcUuK.dpuf

Nelson-Sathi S et al. (2014) **Origins of major archaeal clades correspond to gene acquisitions from bacteria**. Nature, doi:10.1038/nature13805. <https://www.uni-due.de/de/presse/meldung.php?id=8687>
<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature13805.html>

Boto L (2014) **Horizontal gene transfer in the acquisition of novel traits by metazoans**. Proc. R. Soc. B 281, 20132450 <http://rspb.royalsocietypublishing.org/content/281/1777/20132450>
<http://rspb.royalsocietypublishing.org/content/royprsb/281/1777/20132450.full.pdf>

Mayoral J et al. (2014) **Wolbachia small noncoding RNAs and their role in cross-kingdom communications**. PNAS, doi:10.1073/pnas.1420131112

Chou S, Daugherty MD, Peterson SB (2014) **Transferred interbacterial antagonism genes augment eukaryotic innate immune function**. Nature. doi:10.1038/nature13965
<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature13965.html>
« Our work demonstrates that a family of horizontally acquired toxins honed to mediate interbacterial antagonism confers previously undescribed antibacterial capacity to eukaryotes. We speculate that the selective pressure

imposed by competition between bacteria has produced a reservoir of genes encoding diverse antimicrobial functions that are tailored for co-option by eukaryotic innate immune systems. Eucaryotes can acquire new functions through the exchange of genetic material with other domains of life. »

Petersen J, Dubilier N (2014) **Gene swapping in the dead zone.** eLife. 3, e04600 doi: 10.7554/eLife.04600 <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4194449/>

Koonin EV, Krupovic M (2015) **A Movable Defense.** In the evolutionary arms race between pathogens and hosts, genetic elements known as transposons are regularly recruited as assault weapons for cellular defense. The Scientist. <http://www.the-scientist.com/?articles.view/articleNo/41702/title/A-Movable-Defense/>
„It seems that the entire history of life is an incessant game of tug-of-war between such mobile genetic elements (MGEs) and their cellular hosts. MGEs pervade the biosphere. In all studied habitats, from the oceans to soil to the human intestine, the number of detectable virus particles, primarily bacteriophages, exceeds the number of cells at least tenfold, and maybe much more. Furthermore, MGEs and their remnants constitute large portions of many organisms' genomes—as much as two-thirds of the human genome and up to 90 percent in plants such as corn ».

Crisp A et al. (2015) **Expression of multiple horizontally acquired genes is a hallmark of both vertebrate and invertebrate genomes.** doi:10.1186/s13059-015-0607-3, Genome Biology. 16, 50 <http://genomebiology.com/2015/16/1/50>

„We argue that HGT has occurred, and continues to occur, on a previously unsuspected scale in metazoans and is likely to have contributed to biochemical diversification during animal evolution.“

Sieber KB et al. (2016) **Modeling the integration of bacterial rRNA fragments into the human cancer genome.** BMC Bioinformatics, 17, 134.

Sorg RA, Lin L, van Doorn GS, et al. (2016) **Collective Resistance in Microbial Communities by Intracellular Antibiotic Deactivation** PLOS Biology, Biology. <http://dx.doi.org/10.1371/journal.pbio.2000631>
<http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2000631>

Bechtold KT, Rebman AW, Crowder LA, Johnson-Greene D, Aucott JN (2017) **Standardized Symptom Measurement of Individuals with Early Lyme Disease Over Time.** Arch Clin Neuropsychol. 32(2), 129-141.

Cervantes J (2017) **Doctor says you are cured, but you still feel the pain. Borrelia DNA persistence in Lyme disease.** Microbes Infect. In Cameron D. <http://danielcameronmd.com/doctor-says-cured-still-feel-pain/>

Chrostek E, Pelz-Stelinski K, Hurst GDD, Hughes GL (2017) **Horizontal Transmission of Intracellular Insect Symbionts via Plants.** Front Microbiol. 8, 2237. doi: 10.3389/fmicb.2017.02237. eCollection 2017. <https://www.ncbi.nlm.nih.gov/pubmed/29234308>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5712413/>

„Transmission of symbionts through plants likely represents an underappreciated means of infection, both in terms of symbiont epidemiology and the movement of symbionts to new host species.“

Bernard Q, Smith AA, Yang X, Koci J, Foor SD, Cramer SD, Zhuang X, Dwyer JE, Lin YP, Mongodin EF, Marques A, Leong JM, Anguita J, Pal U (2018) **Plasticity in early immune evasion strategies of a bacterial pathogen.** Proc Natl Acad Sci U S A. pii: 201718595. doi:10.1073/pnas.1718595115. <https://doi.org/10.1073/pnas.1718595115>
<http://www.pnas.org/content/early/2018/03/28/1718595115>

„We also discovered a remarkable plasticity in BBA57-mediated spirochete immune evasion strategy because its loss, although resulting in near clearance of pathogens at the inoculum site, triggers nonheritable adaptive changes that exclude detectable nucleotide alterations in the genome but incorporate transcriptional reprogramming events. Understanding the malleability in spirochetal immune evasion mechanisms that ensures their host persistence is critical for the development of novel therapeutic and preventive approaches to combat long-term infections like Lyme borreliosis.“

Searching journal content for horizontal gene transfer (as phrase) in full text

<http://www.pnas.org/search?fulltext=horizontal+gene+transfer&sortspec=date&submit=Submit&andorexactfulltext=phrase>

➔ **Supportive Oligonucleotide Technique (SOT), Micro RNA**
<http://www.xerlebnishaft.de/krebsstammzelltherapie.pdf>

- **RNA-Welt** <http://www.xerlebnishaft.de/rna.pdf>
- **Bakteriophagen – Therapie** <http://www.kabilahsystems.de/bakteriophagen.pdf>
- **Selbst-Muster-Nano** http://www.erlebnishaft.de/selbst_muster_nano.pdf
- **Methylzyklus** <http://www.erlebnishaft.de/methylierung.pdf>
- **Bild Methyl Arginin** <http://www.xerlebnishaft.de/bildmethyl-arginin.pdf>
- **Borreliose und Ko-Infektionen, Vasculitis / Inflammation, Lymphom, Neoplasma** http://www.xerlebnishaft.de/borrel_inflam_lymphom_neopl.pdf
- **Biogene Amine und Peptide** <http://www.kabilahsystems.de/biogeneamineundpeptide.pdf>
- **Immunität** http://www.erlebnishaft.de/danger_model.pdf

- **Prione** <http://www.erlebnishaft.de/prione.pdf>

[Bernt - Dieter Huismans](#). Letzte Revision Mai 2019 www.Huismans.click



Back to top: <http://www.erlebnishaft.de/gentransfer.pdf>