

TM  
N 28/n

# nature

---

# REVIEWS

december 2014 volume 12 no. 12  
[www.nature.com/reviews](http://www.nature.com/reviews)

## MICROBIOLOGY



### LONG-TERM STORAGE

The importance of sample archiving  
in microbial ecology

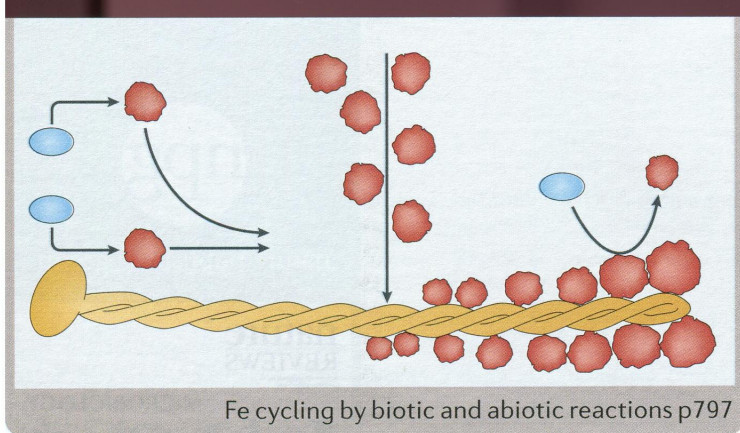
### Energy conservation in acetogenic bacteria

Life at the thermodynamic limit



# CONTENTS

December 2014  
volume 12 no. 12



Fe cycling by biotic and abiotic reactions p797

## REVIEWS

797  
FEATURED  
ARTICLE

### The interplay of microbially mediated and abiotic reactions in the biogeochemical Fe cycle

Emily D. Melton, Elizabeth D. Swanner, Sebastian Behrens, Caroline Schmidt and Andreas Kappler

To understand the network of reactions within the biogeochemical iron (Fe) cycle, it is necessary to determine which abiotic or microbially mediated reactions are dominant under various environmental conditions. Kappler and colleagues review the major biotic and abiotic reactions in the biogeochemical Fe cycle.

809

### Autotrophy at the thermodynamic limit of life: a model for energy conservation in acetogenic bacteria

Kai Schuchmann and Volker Müller

Acetogenic bacteria rely on the reduction of  $\text{CO}_2$  to acetate by the Wood–Ljungdahl pathway to couple energy conservation and biomass production. However, how energy is conserved in acetogens has been an enigma. Here, Schuchmann and Müller describe recent insights into the biochemistry and genetics of the energy metabolism of model acetogens, highlight how these bacteria link  $\text{CO}_2$  fixation to energy conservation and propose a new bioenergetic classification for acetogens.

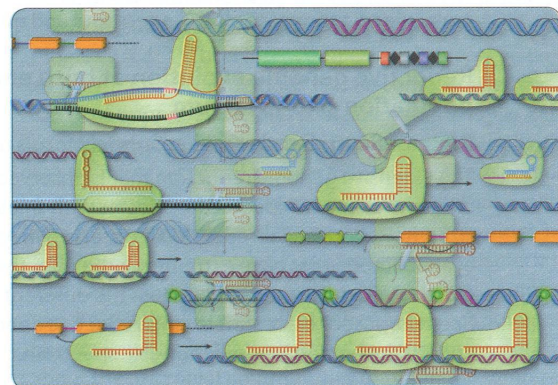
822

### Enabling the ‘host jump’: structural determinants of receptor-binding specificity in influenza A viruses

Yi Shi, Ying Wu, Wei Zhang, Jianxun Qi and George F. Gao

The shift in the receptor-binding specificity of influenza A viruses is mostly determined by mutations in viral haemagglutinin. In this Review, Gao and colleagues discuss recent crystallographic studies that provide molecular insights into haemagglutinin–host receptor interactions that have enabled several influenza A virus subtypes to ‘jump’ from avian to human hosts.

## NATURE REVIEWS MICROBIOLOGY CALENDAR 2015



Free with this issue thanks to support from OriGene

## On the web [www.nature.com/reviews/micro](http://www.nature.com/reviews/micro)

### Advance online publication

We operate an advance online publication (AOP) service for authors and readers to view the latest articles published online ahead of print.

At the centre: influenza A virus ribonucleoproteins  
Amie J. Eisfeld, Gabriele Neumann and Yoshihiro Kawaoka  
Molecular mechanisms of antibiotic resistance  
Jessica M. A. Blair, Mark A. Webber, Alison J. Baylay, David O. Ogbolu and Laura J.V. Piddock

*Nature Reviews Microbiology* (ISSN 1740-1526) is published monthly by Nature Publishing Group, a division of Macmillan Publishers Ltd, The Macmillan Building, 4 Crinan Street, London N1 9XW, UK. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form (electronic or otherwise) without prior permission from [permissions@nature.com](mailto:permissions@nature.com). US Periodicals postage paid at Jamaica, NY, and additional mailing post offices. US POSTMASTER: Send address changes to Nature Publishing Group, Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA.  
© 2014 Macmillan Publishers Limited. All rights reserved. Printed in United Kingdom.

## SERIES ON VECTOR-BORNE DISEASES

In this article series, *Nature Reviews Microbiology* highlights the distinct features of a range of vector-borne pathogens and the diseases they cause, as well as how the host responds to these infections. All articles in the series can be found at <http://www.nature.com/nrmicro/series/vectorbornediseases/index.html>

### Links to further information

The full text of articles includes author biographies, links to glossary terms and links to websites and databases with relevant information.

### E-alert table of contents

Get monthly e-mail alerts to the content of this journal — sent FREE to your inbox — by registering online. Or sign up to receive the latest content as an RSS newsfeed by visiting [www.nature.com/reviews/micro](http://www.nature.com/reviews/micro)

### Online correspondence

Comments from readers about our articles. All correspondence will be highlighted on the table of contents and on e-mail alerts. See page 850.

Федеральное государственное бюджетное учреждение науки  
Центральная научная библиотека  
Уральского отделения  
Российской академии наук (ЦНБ УрО РАН)



## COMMENT

- 789 **The importance of sample archiving in microbial ecology**  
*S. Craig Cary and Noah Fierer*

## RESEARCH HIGHLIGHTS

- 791 Selections from the recent scientific literature

## NEWS & ANALYSIS

- 795 **Genome watch** Recombination: genomic mix 'n' match

## PERSPECTIVES

### OPINION

- 833 **Asymptomatic malaria infections: detectability, transmissibility and public health relevance**



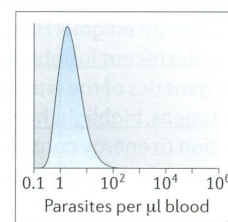
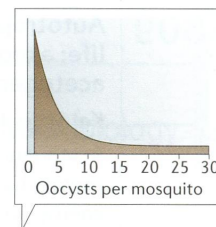
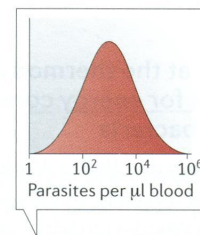
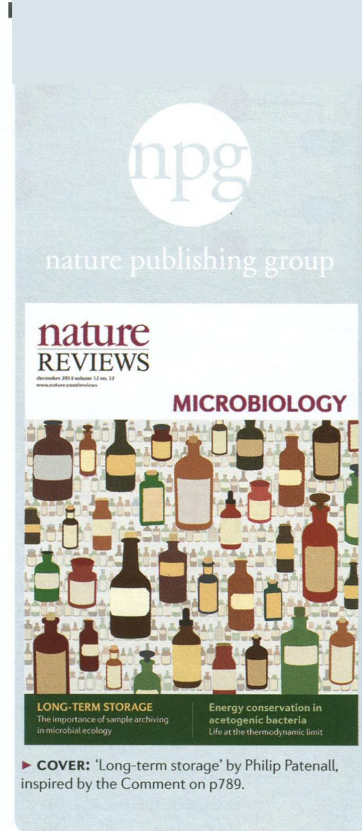
*Teun Bousema, Lucy Okell, Ingrid Felger and Chris Drakeley*

Recent studies have shown that submicroscopic *Plasmodium falciparum* infections are an important, but often undetected, reservoir of malaria and are major contributors to transmission. In this Opinion article, Bousema *et al.* discuss the epidemiology of these infections and the prospects for intervention strategies, and they argue for the wider deployment of molecular diagnostic tools to understand and quantify infection dynamics.

- 841 **Reductive genome evolution at both ends of the bacterial population size spectrum**

*B er nice Batut, Carole Knibbe, Gabriel Marais and Vincent Daubin*

The extensive genome reduction that is observed in bacterial endosymbionts is expected for species with small effective population sizes; however, similar reduction is observed in some free-living marine cyanobacteria that have extremely large effective population sizes. In this Opinion article, the authors discuss the different hypotheses that have been proposed to account for this reductive genome evolution at both ends of the bacterial population size spectrum.



833

### EDITORIAL & PRODUCTION OFFICE

The Macmillan Building, 4 Crinan Street, London N1 9XW, UK  
 Tel: +44 (0)20 7843 3620  
 Email: [NatureReviews@nature.com](mailto:NatureReviews@nature.com)  
[www.nature.com/reviews/micro](http://www.nature.com/reviews/micro)

**CHIEF EDITOR** Sheilagh Molloy  
**SENIOR EDITOR** Christina Tobin K ahrstr om  
**ASSOCIATE EDITOR** Cl audio Nunes-Alves  
**ASSISTANT EDITOR** Andrea Du Toit  
**SENIOR COPY EDITOR (NRMICRO)** Jennifer Thorley  
**ART EDITOR** Philip Patenall  
**COPY EDITING MANAGER** Yuki Ozawa  
**SENIOR COPY EDITORS** Esther Lau, Simon Neil, Lydia Shipman

**EDITORIAL ASSISTANTS** Rebecca Cromie, Amy McWalters  
**MANAGING PRODUCTION EDITOR** Judith Shadwell  
**SENIOR PRODUCTION EDITOR** Simon Fenwick  
**ART CONTROLLER** Susanne Harris  
**SENIOR ART EDITORS** Patrick Morgan, Vicky Summersby  
**PRODUCTION CONTROLLER** Natalie Smith  
**EXECUTIVE EDITOR** Arianne Heinrichs  
**NATURE EDITORIAL DIRECTOR** Ritu Dhand  
**EDITORIAL DIRECTOR** Alison Mitchell

**CUSTOMER SERVICES** [www.nature.com/help](http://www.nature.com/help)  
**PERSONAL SUBSCRIPTIONS** [subscriptions@nature.com](mailto:subscriptions@nature.com)  
**REPRINTS** [www.nature.com/reprints](http://www.nature.com/reprints)

**ADVERTISING & SPONSORSHIP**  
[www.nature.com/advertising](http://www.nature.com/advertising)  
**SITE LICENCES**  
[www.nature.com/libraries/site\\_licenses/index.html](http://www.nature.com/libraries/site_licenses/index.html)  
**PRESS OFFICE** [press@nature.com](mailto:press@nature.com)  
**MARKETING** [marketing@nature.com](mailto:marketing@nature.com)

### MANAGEMENT OFFICES

**NPG LONDON** The Macmillan Building, 4 Crinan Street, London N1 9XW, UK. Tel: +44 (0)20 7833 4000  
**NPG NEW YORK** 75 Varick Street, 9th floor, New York, NY 10013-1917, USA. Tel: +1 212 726 9200  
**NPG ASIA-PACIFIC** Chiyoda Building 2-37 Ichigayatamachi, Shinjuku-Ku, Tokyo 16200843, Japan. Tel: +1 212 726 9200  
 A list of other offices can be found at [www.nature.com/npg\\_/contact/offices.html](http://www.nature.com/npg_/contact/offices.html)

Copyright   2014 Nature Publishing Group  
 Printed in Wales by Cambrian Printers on acid-free paper.

### EDITORS



SHEILAGH MOLLOY



CHRISTINA TOBIN K AHRSTR OM



CL AUDIO NUNES-ALVES



ANDREA DU TOIT