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Christof Koch ponders consciousness and our place in the Universe [PAGE 29](#)

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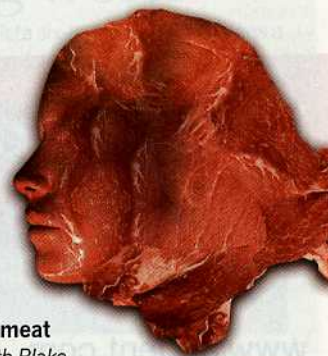
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##### An insect to fill the gap

A complete Devonian insect fossil narrows the Hexapoda gap

William A Shear [SEE LETTER P.82](#)

#### 35 EARTH SCIENCE

##### The balance of the carbon budget

Total global carbon sinks have increased during the past 50 years

Ingeborg Levin [SEE LETTER P.70](#)

#### 36 DRUG DISCOVERY

##### Kill the messenger where it lives

Antisense molecules target a toxic mRNA for destruction in the nucleus

Peter K Todd & Henry L Paulson

[SEE LETTER P.111](#)

#### 38 ALZHEIMER'S DISEASE

##### A protective mutation

Gene variant reduces accumulation of amyloid- $\beta$  peptides in the brain

Bart De Strooper & Thierry Voet

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#### 39 QUANTUM OPTICS

##### Strongly interacting photons

A medium that is transparent to single photons

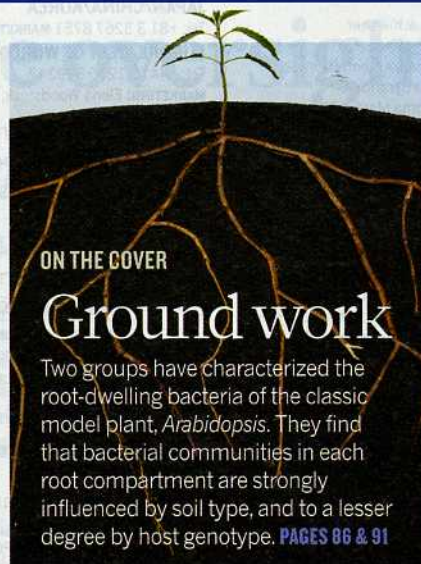
Thad G Walker [SEE LETTER P.57](#)

#### 40 SYSTEMS BIOLOGY

##### A cell in a computer

Modelling every cellular process in dividing *Mycoplasma* bacteria

Mark Isalan



ON THE COVER

## Ground work

Two groups have characterized the root-dwelling bacteria of the classic model plant, *Arabidopsis*. They find that bacterial communities in each root compartment are strongly influenced by soil type, and to a lesser degree by host genotype. [PAGES 86 & 91](#)

### ARTICLES

#### 43 CANCER Novel mutations target distinct subgroups of medulloblastoma

G Robinson et al.

#### 49 CANCER Subgroup-specific structural variation across 1,000 medulloblastoma genomes

P A Northcott et al.

### LETTERS

#### 57 PHYSICS Quantum nonlinear optics with single photons enabled by strongly interacting atoms

T Peyronel et al. [SEE N&V P.39](#)

#### 61 MATERIALS Quantum phase transition in a resonant level coupled to interacting leads

H T Mebrahtu et al.

#### 65 PHYSICS A Newtonian approach to extraordinarily strong negative refraction

H Yoon, K Y M Yeung, V Umansky & D Ham

#### 70 ENVIRONMENT Increase in observed net carbon dioxide uptake by land and oceans during the past 50 years

A P Ballantyne, C B Alden, J B Miller, P P Tans & J W C White [SEE N&V P.35](#)

#### 73 EARTH SCIENCE Persistent near-tropical warmth on the Antarctic continent during the early Eocene epoch

J Pross et al.

#### 78 ECOLOGY Universal species–area and endemics–area relationships at continental scales

D Storch, P Keil & W Jetz

#### 82 EVOLUTION A complete insect from the Late Devonian period

R Garrouste et al. [SEE N&V P.34](#)

#### 86 MICROBIOLOGY Defining the core *Arabidopsis thaliana* root microbiome

D S Lundberg et al.

#### 91 MICROBIOLOGY Revealing structure and assembly cues for *Arabidopsis* root-inhabiting bacterial microbiota

D Bulgarelli et al.

#### 96 CELL BIOLOGY A mutation in *APP* protects against Alzheimer's disease and age-related cognitive decline

T Jonsson et al. [SEE N&V P.38](#)

#### 100 CANCER Dissecting the genomic complexity underlying medulloblastoma

D T W Jones et al.

#### 106 CANCER Medulloblastoma exome sequencing uncovers subtype-specific somatic mutations

T J Pugh et al.

#### 111 THERAPEUTICS Targeting nuclear RNA for *in vivo* correction of myotonic dystrophy

T M Wheeler et al. [SEE N&V P.36](#)

#### 116 GENOMICS A map of the *cis*-regulatory sequences in the mouse genome

Y Shen et al.

### EVOLUTION

## Leg work

A complete six-legged insect bridges a gap in the fossil record. [PAGE 82](#)



PHYSICS

## Light work

An step towards all-optical quantum information processing. [PAGE 57](#)