References

Aktuell

Evans 2018

Tracy Evans, *Heed the call to change.* science **361** (2018), 198.

I needed a change. Just a few years earlier, I stood at the edge of the swamp under a massive hollow cypress tree reading Winnie-the-Pooh to a group of 5- and 6-year-olds. As a naturalist at a state park, my goal was to introduce these children to the nature found in their own backyard. I played a tape of owl calls to accompany the story. Just then, an owl swooped down over our heads, startling and delighting us. "I can't believe I'm actually getting paid to have this much fun!" I thought to myself. But over time, my job changed. Sitting at my desk, staring at environmental impact reports and grant applications on my computer screen, I began to think, "They cannot pay me enough to do this job." It was another turning point in the winding road that led me, at age 66, to earn a Ph.D.

Floryan 2018

Daniel Floryan, Tyler Van Buren & Alexander J. Smits, *Efficient cruising for swimming and flying animals is dictated by fluid drag.* PNAS **115** (2018), 8116–8118.

pnas115-08116-Supplement.pdf

Many swimming and flying animals are observed to cruise in a narrow range of Strouhal numbers, where the Strouhal number $St = 2fA/U$ is a dimensionless parameter that relates stroke frequency f, amplitude A, and forward speed U. Dolphins, sharks, bony fish, birds, bats, and insects typically cruise in the range $0.2 < St < 0.4$, which coincides with the Strouhal number range for maximum efficiency as found by experiments on heaving and pitching airfoils. It has therefore been postulated that natural selection has tuned animals to use this range of Strouhal numbers because it confers high efficiency, but the reason why this is so is still unclear. Here, by using simple scaling arguments, we argue that the Strouhal number for peak efficiency is largely determined by fluid drag on the fins and wings.

Keywords: swimming | flight | biolocomotion | drag

Significance: Almost 30 y ago, researchers discovered that a great variety of efficient swimmers cruise in a narrow range of Strouhal numbers, a dimensionless number describing the kinematics of swimming. Almost 15 y later, separate researchers discovered that fliers (bats, birds, and insects) also cruise in the same narrow range of Strouhal numbers. Attendant experiments on flapping airfoils have shown that this narrow range of Strouhal numbers gives rise to the most efficient kinematics. Here, we explain why this range of Strouhal numbers is the most efficient.

Hasegawa 2018

Tomoko Hasegawa et al., *Risk of increased food insecurity under stringent global climate change mitigation policy.* nature climate change **8** (2018), 699–703.

Natclimch08-699-Supplement.pdf

Tomoko Hasegawa, Shinichiro Fujimori, Petr Havlík, Hugo Valin, Benjamin Leon Bodirsky, Jonathan C. Doelman, Thomas Fellmann, Page Kyle, Jason F. L. Koopman, Hermann Lotze-Campen, Daniel Mason-D'Croz, Yuki Ochi, Ignacio Pérez Domínguez, Elke Stehfest, Timothy B. Sulser, Andrzej Tabeau, Kiyoshi Takahashi, Jun'ya Takakura, Hans van Meijl, Willem-Jan van Zeist, Keith Wiebe & Peter Witzke

Food insecurity can be directly exacerbated by climate change due to crop-production-related impacts of warmer and drier conditions that are expected in important agricultural regions1–3. However, efforts to mitigate climate change through comprehensive, economy-wide GHG emissions reductions may also negatively affect food security, due to indirect impacts on prices and supplies of key agricultural commodities4–6. Here we conduct a multiple model assessment on the combined effects of climate change and climate mitigation efforts on agricultural commodity prices, dietary energy availability and the population at risk of hunger. A robust finding is that by 2050, stringent climate mitigation policy, if implemented evenly across all sectors and regions, would have a greater negative impact on global hunger and food consumption than the direct impacts of climate change. The negative impacts would be most prevalent in vulnerable, low-income regions such as sub-Saharan Africa and South Asia, where food security problems are already acute.

Kwok 2018

Roberta Kwok, *Lab notebooks go digital.* nature **560** (2018), 269–270.
A burgeoning array of digital tools is helping researchers to document experiments with ease.

Lean 2018

Michael E. Lean et al., *Primary care-led weight management for remission of type 2 diabetes (DiRECT), An open-label, cluster-randomised trial.* The Lancet **391** (2018), 541–551.
Lancet391-0541-Supplement.pdf
Keywords: Michael E Lean, Wilma S Leslie, Alison C Barnes, Naomi Brosnahan, George Thom, Louise McCombie, Carl Peters, Sviatlana Zhyzhneuskaya, Ahmad Al-Mrabeh, Kieren G Hollingsworth, Angela M Rodrigues, Lucia Rehackova, Ashley Adamson, Falko F Sniehotta, John C Mathers, Hazel M Ross, Yvonne McIlvenna, Renae Stefanetti, Michael Trenell, Paul Welsh, Sharon Kean, Ian Ford, Alex McConnachie, Naveed Sattar, Roy Taylor
Background Type 2 diabetes is a chronic disorder that requires lifelong treatment. We aimed to assess whether intensive weight management within routine primary care would achieve remission of type 2 diabetes.
Methods We did this open-label, cluster-randomised trial (DiRECT) at 49 primary care practices in Scotland and the Tyneside region of England. Practices were randomly assigned (1:1), via a computer-generated list, to provide either a weight management programme (intervention) or best-practice care by guidelines (control), with stratification for study site (Tyneside or Scotland) and practice list size (>5700 or ≤5700). Participants, carers, and research assistants who collected outcome data were aware of group allocation; however, allocation was concealed from the study statistician. We recruited individuals aged 20–65 years who had been diagnosed with type 2 diabetes within the past 6 years, had a body-mass index of 27–45 kg/m2, and were not receiving insulin. The intervention comprised withdrawal of antidiabetic and antihypertensive drugs, total diet replacement (825–853 kcal/day formula diet for 3–5 months), stepped food reintroduction (2–8 weeks), and structured support for long-term weight loss maintenance. Co-primary

outcomes were weight loss of 15 kg or more, and remission of diabetes, defined as glycated haemoglobin (HbA1c) of less than 6·5 % (<48 mmol/mol) after at least 2 months off all antidiabetic medications, from baseline to 12 months. These outcomes were analysed hierarchically. This trial is registered with the ISRCTN registry, number 03267836.

Findings Between July 25, 2014, and Aug 5, 2017, we recruited 306 individuals from 49 intervention (n=23) and control (n=26) general practices; 149 participants per group comprised the intention-to-treat population. At 12 months, we recorded weight loss of 15 kg or more in 36 (24 %) participants in the intervention group and no participants in the control group (p<0·0001). Diabetes remission was achieved in 68 (46 %) participants in the intervention group and six (4 %) participants in the control group (odds ratio 19·7, 95 % CI 7·8–49·8; p<0·0001). Remission varied with weight loss in the whole study population, with achievement in none of 76 participants who gained weight, six (7 %) of 89 participants who maintained 0–5 kg weight loss, 19 (34 %) of 56 participants with 5–10 kg loss, 16 (57 %) of 28 participants with 10–15 kg loss, and 31 (86 %) of 36 participants who lost 15 kg or more. Mean bodyweight fell by 10·0 kg (SD 8·0) in the intervention group and 1·0 kg (3·7) in the control group (adjusted difference –8·8 kg, 95 % CI –10·3 to –7·3; p<0·0001). Quality of life, as measured by the EuroQol 5 Dimensions visual analogue scale, improved by 7·2 points (SD 21·3) in the intervention group, and decreased by 2·9 points (15·5) in the control group (adjusted difference 6·4 points, 95 % CI 2·5–10·3; p=0·0012). Nine serious adverse events were reported by seven (4 %) of 157 participants in the intervention group and two were reported by two (1 %) participants in the control group. Two serious adverse events (biliary colic and abdominal pain), occurring in the same participant, were deemed potentially related to the intervention. No serious adverse events led to withdrawal from the study.

Interpretation Our findings show that, at 12 months, almost half of participants achieved remission to a non-diabetic state and off antidiabetic drugs. Remission of type 2 diabetes is a practical target for primary care.

Lochy 2018

Aliette Lochy, Corentin Jacques, Louis Maillard, Sophie Colnat-Coulbois, Bruno Rossion & Jacques Jonas, *Selective visual representation of letters and words in the left ventral occipito-temporal cortex with intracerebral recordings.* PNAS **115** (2018), E7595–E7604.

pnas115-E07595-Supplement1.pdf, pnas115-E07595-Supplement2.avi, pnas115-E07595-Supplement3.avi, pnas115-E07595-Supplement4.avi

We report a comprehensive cartography of selective responses to visual letters and words in the human ventral occipito-temporal cortex (VOTC) with direct neural recordings, clarifying key aspects of the neural basis of reading. Intracerebral recordings were performed in a large group of patients (n = 37) presented with visual words inserted periodically in rapid sequences of pseudofonts, nonwords, or pseudowords, enabling classification of responses at three levels of word processing: letter, prelexical, and lexical. While letterselective responses are found in much of the VOTC, with a higher proportion in left posterior regions, prelexical/lexical responses are confined to the middle and anterior sections of the left fusiform gyrus. This region overlaps with and extends more anteriorly than the visual word form area typically identified with functional magnetic resonance imaging. In this region, prelexical responses provide evidence for populations of neurons sensitive to the statistical regularity of letter combinations independently of lexical responses to familiar words. Despite extensive sampling in anterior ventral temporal regions, there is no hierarchical organization between prelexical and lexical responses in

the left fusiform gyrus. Overall, distinct word processing levels depend on neural populations that are spatially intermingled rather than organized according to a strict posteroanterior hierarchy in the left VOTC.

Keywords: word reading | lexical representation | intracerebral recordings | SEEG | fusiform gyrus

Significance: The left ventral occipito-temporal cortex (VOTC) is a critical part of the reading circuitry. We made measurements with intracerebral electrodes in 37 participants to understand whether this region contains functionally separated brain loci for processing letters and words. Letter-selective responses are found in much of VOTC. Responses to word forms are absent in posterior VOTC but are present and intermingled with letter-specific responses in left anterior VOTC. The results are inconsistent with a hierarchical model in which posterior regions uniquely perform letter identification functions and increasingly anterior regions perform increasingly complex linguistic functions.

DA MESQUITA 2018

Sandro Da Mesquita et al., *Functional aspects of meningeal lymphatics in ageing and Alzheimer's disease.* nature **560** (2018), 185–191.

n560-0185-Supplement.pdf

Sandro Da Mesquita, Antoine Louveau, Andrea Vaccari, Igor Smirnov, R. Chase Cornelison, Kathryn M. Kingsmore, Christian Contarino, Suna Onengut-Gumuscu, Emily Farber, Daniel Raper, Kenneth E. Viar, Romie D. Powell, Wendy Baker, Nisha Dabhi, Robin Bai, Rui Cao, Song Hu, Stephen S. Rich, Jennifer M. Munson, M. Beatriz Lopes, Christopher C. Overall, Scott T. Acton & Jonathan Kipnis

Ageing is a major risk factor for many neurological pathologies, but its mechanisms remain unclear. Unlike other tissues, the parenchyma of the central nervous system (CNS) lacks lymphatic vasculature and waste products are removed partly through a paravascular route. (Re)discovery and characterization of meningeal lymphatic vessels has prompted an assessment of their role in waste clearance from the CNS. Here we show that meningeal lymphatic vessels drain macromolecules from the CNS (cerebrospinal and interstitial fluids) into the cervical lymph nodes in mice. Impairment of meningeal lymphatic function slows paravascular influx of macromolecules into the brain and efflux of macromolecules from the interstitial fluid, and induces cognitive impairment in mice. Treatment of aged mice with vascular endothelial growth factor C enhances meningeal lymphatic drainage of macromolecules from the cerebrospinal fluid, improving brain perfusion and learning and memory performance. Disruption of meningeal lymphatic vessels in transgenic mouse models of Alzheimer's disease promotes amyloid-â deposition in the meninges, which resembles human meningeal pathology, and aggravates parenchymal amyloid-â accumulation. Meningeal lymphatic dysfunction may be an aggravating factor in Alzheimer's disease pathology and in age-associated cognitive decline. Thus, augmentation of meningeal lymphatic function might be a promising therapeutic target for preventing or delaying age-associated neurological diseases.

PRADHAN 2018

Deepti Pradhan, *Working science into fundraising.* science **361** (2018), 302.

Perhaps what the past decade has taught me most is that scientific training and a scientific mindset will serve you well, no matter what you end up doing. Although the skills you gain in the lab might seem very specialized, the reality is that the analytic rigor that science teaches and demands is critical for success in any field. And for those who, like me, find themselves leaving the lab, the open-mindedness that is required of a good scientist is an asset when you have to recalibrate yourself to a new career.

Sweeney 2018

Melanie D. Sweeney & Berislav V. Zlokovic, *Lymphatic waste disposal in the brain.* nature **560** (2018), 172–174.

The discovery that a set of lymphatic vessels interacts with blood vessels to remove toxic waste products from the brain has implications for cognition, ageing and disorders such as Alzheimer's disease.

Sweis 2018

Brian M. Sweis et al., *Sensitivity to "sunk costs" in mice, rats, and humans.* science **361** (2018), 178–181.

s361-0178-Supplement.pdf

Brian M. Sweis, Samantha V. Abram, Brandy J. Schmidt, Kelsey D. Seeland, Angus W. MacDonald III, Mark J. Thomas & A. David Redish

Sunk costs are irrecoverable investments that should not influence decisions, because decisions should be made on the basis of expected future consequences. Both human and nonhuman animals can show sensitivity to sunk costs, but reports from across species are inconsistent. In a temporal context, a sensitivity to sunk costs arises when an individual resists ending an activity, even if it seems unproductive, because of the time already invested. In two parallel foraging tasks that we designed, we found that mice, rats, and humans show similar sensitivities to sunk costs in their decision-making. Unexpectedly, sensitivity to time invested accrued only after an initial decision had been made. These findings suggest that sensitivity to temporal sunk costs lies in a vulnerability distinct from deliberation processes and that this distinction is present across species.

Taylor 2018

Graham K. Taylor, *Simple scaling law predicts peak efficiency in oscillatory propulsion.* PNAS **115** (2018), 8063–8065.

Biologie

Lindstedt 2018

Carita Lindstedt, Antti Miettinen, Dalial Freitak, Tarmo Ketola, Andres López-Sepulcre & Elina Mäntylä& Hannu Pakkanen, *Ecological conditions alter cooperative behaviour and its costs in a chemically defended sawfly.* Proc. Royal Society B **285** (2018), 20180466.

ProcRSocB285-20180466-Supplement.pdf

The evolution of cooperation and social behaviour is often studied in isolation from the ecology of organisms. Yet, the selective environment under which individuals evolve is much more complex in nature, consisting of ecological and abiotic interactions in addition to social ones. Here, we measured the life-history costs of cooperative chemical defence in a gregarious social herbivore, Diprion pini pine sawfly larvae, and how these costs vary under different ecological conditions. We ran a rearing experiment wherewe manipulated diet (resin content) and attack intensity by repeatedly harassing larvae to produce a chemical defence. We show that forcing individuals to allocate more to cooperative defence (high attack intensity) incurred a clear cost by decreasing individual survival and potency of chemical defence. Cooperative behaviour and the magnitude of its costs were further shaped by host plant quality. The number of individuals participating in group defence, immune responses and female growth decreased on a high resin diet under high attack intensity. We also found some benefits of cheating: non-defending males had

higher growth rates across treatments. Taken together, these results suggest that ecological interactions can shape the adaptive value of cooperative behaviour and maintain variation in the frequency of cooperation and cheating.

Energie

Rau 2018

Greg H. Rau, Heather D. Willauer & Zhiyong Jason Ren, *The global potential for converting renewable electricity to negative-CO2-emissions hydrogen.* nature climate change **8** (2018), 621–625.

The IPCC has assigned a critical role to negative-CO2-emissions energy in meeting energy and climate goals by the end of the century, with biomass energy plus carbon capture and storage (BECCS) prominently featured. We estimate that methods of combining saline water electrolysis with mineral weathering powered by any source of non-fossil fuel-derived electricity could, on average, increase energy generation and CO2 removal by > 50 times relative to BECCS, at equivalent or lower cost. This electrogeochemistry avoids the need to produce and store concentrated CO2, instead converting and sequestering CO2 as already abundant, long-lived forms of ocean alkalinity. Such energy systems could also greatly reduce land and freshwater impacts relative to BECCS, and could also be integrated into conventional energy production to reduce its carbon footprint. Further research is needed to better understand the full range and capacity of the world's negative-emissions options.

Service 2018

Robert F. Service, *Liquid Sunshine.* science **361** (2018), 120–123.

Ammonia made from sun, air, and water could turn Australia into a renewable energy superpower.

All told, Australia boasts a renewable energy potential of 25,000 gigawatts, one of the highest in the world and about four times the planet's installed electricity production capacity. Yet with a small population and few ways to store or export the energy, its renewable bounty is largely untapped.

Converting hydrogen into ammonia only to convert it back again might seem strange. But hydrogen is hard to ship: It has to be liquefied by chilling it to temperatures below –253°C, using up a third of its energy content. Ammonia, by contrast, liquefies at –10°C under a bit of pressure. The energy penalty of converting the hydrogen to ammonia and back is roughly the same as chilling hydrogen, Dolan says—and because far more infrastructure already exists for handling and transporting ammonia, he says, ammonia is the safer bet.

Klima

Carré 2018

Matthieu Carré et al., *Modern drought conditions in western Sahel unprecedented in the past 1600 years.* Climate Dynamics (2018), preprint, 1–16. DOI:10.1007/s00382-018-4311-3.

ClimDyn2018.08-Carre-Supplement1.xlsx, ClimDyn2018.08-Carre-Supplement2.xlsx, ClimDyn2018.08-Carre-Supplement3.txt

Matthieu Carré, Moufok Azzoug, Paul Zaharias, Abdoulaye Camara, Rachid Cheddadi, Manuel Chevalier, Denis Fiorillo, Amadou T. Gaye, Serge Janicot, Myriam Khodri, Alban Lazar, Claire E. Lazareth, Juliette Mignot, Nancy Mitma García, Nicolas Patris, Océane Perrot & Malick Wade

As climate model uncertainties remain very large for future rainfall in the Sahel, a multi-centennial perspective is required to assess the situation of current Sahel climate in the context of global warming. We present here the first record of hydroclimatic variability over the past 1600 years in Senegal, obtained from stable oxygen isotope analyses (d18O) in archaeological shell middens from the Saloum Delta. During the preindustrial period, the region was relatively humid, with maximum humidity reached during the period from AD 1500 to AD 1800, referred to as the Little Ice Age. A significant negative link is observed at the centennial scale between global temperature and humidity in the Sahel that is at odds with the expected effects of latitudinal shifts of the intertropical convergence zone during the last millennium. In the context of the past 1600 years, the Western Sahel appears to be experiencing today unprecedented drought conditions. The rapid aridification that started ca. AD 1800 and the recent emergence of Sahel drought from the natural variability point to an anthropogenic forcing of Sahel drying trend. This new long-term perspective suggests that the recovery of Sahel rainfall in the last decade may only result from short-term internal variability, and supports climate models that predict an increase of Sahel drought under future greenhouse climate.

Keywords: West African Monsoon | Climate change | Paleoclimate | Shell middens

Lindgren 2018

Amelie Lindgren, Gustaf Hugelius & Peter Kuhry, *Extensive loss of past permafrost carbon but a net accumulation into present-day soils*. nature **560** (2018), 219–222.

n560-0219-Supplement.pdf

Atmospheric concentrations of carbon dioxide increased between the Last Glacial Maximum (LGM, around 21,000 years ago) and the preindustrial era1. It is thought that the evolution of this atmospheric carbon dioxide (and that of atmospheric methane) during the glacial-to-interglacial transition was influenced by organic carbon that was stored in permafrost during the LGM and then underwent decomposition and release following thaw2,3. It has also been suggested that the rather erratic atmospheric d13C and D14C signals seen during deglaciation1,4 could partly be explained by the presence of a large terrestrial inert LGM carbon stock, despite the biosphere being less productive (and therefore storing less carbon)5,6. Here we present an empirically derived estimate of the carbon stored in permafrost during the LGM by reconstructing the extent and carbon content of LGM biomes, peatland regions and deep sedimentary deposits. We find that the total estimated soil carbon stock for the LGM northern permafrost region is smaller than the estimated present-day storage (in both permafrost and non-permafrost soils) for the same region. A substantial decrease in the permafrost area from the LGM to the present day has been accompanied by a roughly 400-petagram increase in the total soil carbon stock. This increase in soil carbon suggests that permafrost carbon has made no net contribution to the atmospheric carbon pool since the LGM. However, our results also indicate potential postglacial reductions in the portion of the carbon stock that is trapped in permafrost, of around 1,000 petagrams, supporting earlier studies7. We further find that carbon has shifted from being primarily stored in permafrost mineral soils and loess deposits during the LGM, to being roughly equally divided between peatlands, mineral soils and permafrost loess deposits today.

Randel 2018

William J. Randel, *The seasonal fingerprint of climate change.* science **361** (2018), 227–228.

Satellite data provide evidence for human impacts on the seasonal temperature cycle.

Santer 2018

Benjamin D. Santer et al., *Human influence on the seasonal cycle of tropospheric temperature.* science **361** (2018), 245.

s361-0245-Supplement.pdf

Benjamin D. Santer, Stephen Po-Chedley, Mark D. Zelinka, Ivana Cvijanovic, Céline Bonfils, Paul J. Durack, Qiang Fu, Jeffrey Kiehl, Carl Mears, Jeffrey Painter, Giuliana Pallotta, Susan Solomon, Frank J. Wentz & Cheng-Zhi Zou

We provide scientific evidence that a human-caused signal in the seasonal cycle of tropospheric temperature has emerged from the background noise of natural variability. Satellite data and the anthropogenic "fingerprint" predicted by climate models show common large-scale changes in geographical patterns of seasonal cycle amplitude. These common features include increases in amplitude at mid-latitudes in both hemispheres, amplitude decreases at high latitudes in the Southern Hemisphere, and small changes in the tropics. Simple physical mechanisms explain these features. The model fingerprint of seasonal cycle changes is identifiable with high statistical confidence in five out of six satellite temperature datasets. Our results suggest that attribution studies with the changing seasonal cycle provide powerful evidence for a significant human effect on Earth's climate.

Story or Book

Ball 2018

Philip Ball, *Two slits, one hell of a quantum conundrum.* nature **Book** (2018), 165.

Philip Ball lauds a study of a famous experiment and the insights it offers into a thoroughly maddening theory.

Through Two Doors at Once: The Elegant Experiment That Captures the Enigma of Our Quantum Reality. Anil Ananthaswamy. Dutton (2018)

Oddest of all, that remains true if we delay the measurement until after the particle has traversed the slits (but before it hits the screen). And if we make the measurement but then delete the result without looking at it, interference returns. At any rate, Bohr was right to advise caution in how we use language.

Still, given that popularization of quantum mechanics seems to be the flavour of the month — summoning [. . .] and my own 2018 Beyond Weird — there's no lack of a wider perspective.

Camargo 2018

Chico Camargo, *Physics makes rules, evolution rolls the dice.* science **361** (2018), 236.

An astrobiologist argues that alien life will likely look a lot like life on Earth.

The Equations of Life. How Physics Shapes Evolution. Charles S. Cockell. Basic Books, 2018, 348 pp.

Because the atoms in the Milky Way behave the same as in any other galaxy, Cockell argues that [. . .] there is no reason to believe that replaying evolution on another planet would lead to unimaginable life forms. Rather, one should expect to see variations on the same theme.