

References

Aktuell

AHLAWAT 2020

Ajit Ahlawat, Alfred Wiedensohler & Sumit Kumar Mishra, *An Overview on the Role of Relative Humidity in Airborne Transmission of SARS-CoV-2 in Indoor Environments*. [Aerosol and Air Quality Research \(2020\), preprint, 1–6](#). DOI:10.4209/aaqr.2020.06.0302.

COVID-19 disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which originated in Wuhan, China and spread with an astonishing rate across the world. The transmission routes of SARS-CoV-2 are still debated, but recent evidence strongly suggests that COVID-19 could be transmitted via air in poorly ventilated places. Some studies also suggest the higher surface stability of SARS-CoV-2 as compared to SARS-CoV-1. It is also possible that small viral particles may enter into indoor environments from the various emission sources aided by environmental factors such as relative humidity, wind speed, temperature, thus representing a type of an aerosol transmission. Here, we explore the role of relative humidity in airborne transmission of SARS-CoV-2 virus in indoor environments based on recent studies around the world. Humidity affects both the evaporation kinematics and particle growth. In dry indoor places i.e., less humidity (< 40 % RH), the chances of airborne transmission of SARS-CoV-2 are higher than that of humid places (i.e., > 90 % RH). Based on earlier studies, a relative humidity of 40–60 % was found to be optimal for human health in indoor places. Thus, it is extremely important to set a minimum relative humidity standard for indoor environments such as hospitals, offices and public transports for minimization of airborne spread of SARS-CoV-2.

Keywords: Aerosol | COVID-19 | SARS-CoV-2 | Indoor | Humidity.

ARVIN 2020

Ann M. Arvin et al., *A perspective on potential antibody-dependent enhancement of SARS-CoV-2*. [nature 584 \(2020\), 353–363](#). DOI:10.1038/s41586-020-2538-8.

n584-0353-Supplement.xlsx

Antibody-dependent enhancement (ADE) of disease is a general concern for the development of vaccines and antibody therapies because the mechanisms that underlie antibody protection against any virus have a theoretical potential to amplify the infection or trigger harmful immunopathology. This possibility requires careful consideration at this critical point in the pandemic of coronavirus disease 2019 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Here we review observations relevant to the risks of ADE of disease, and their potential implications for SARS-CoV-2 infection. At present, there are no known clinical findings, immunological assays or biomarkers that can differentiate any severe viral infection from immune-enhanced disease, whether by measuring antibodies, T cells or intrinsic host responses. In vitro systems and animal models do not predict the risk of ADE of disease, in part because protective and potentially detrimental antibody-mediated mechanisms are the same and designing animal models depends on understanding how antiviral host responses may become harmful in humans. The implications of our lack of knowledge are

twofold. First, comprehensive studies are urgently needed to define clinical correlates of protective immunity against SARS-CoV-2. Second, because ADE of disease cannot be reliably predicted after either vaccination or treatment with antibodies—regardless of what virus is the causative agent—it will be essential to depend on careful analysis of safety in humans as immune interventions for COVID-19 move forward.

Ann M. Arvin, Katja Fink, Michael A. Schmid, Andrea Cathcart, Roberto Spreafico, Colin Havenar-Daughton, Antonio Lanzavecchia, Davide Corti & Herbert W. Virgin

CALLAWAY 2020

Ewen Callaway, *Outrage Over Russia's Fast-Track Coronavirus Vaccine*. [nature](#) **584** (2020), 334–335.

Scientists worry about the immunization's safety because it hasn't been tested in large trials.

COHEN 2020

Andrew N. Cohen, Bruce Kessel & Michael G. Milgroom, *Diagnosing COVID-19 infection: the danger of over-reliance on positive test results, The evidence shows that false positive PCR results are common enough to impact clinical and policy decisions*. [medRxiv](#) **2020, 20080911**, 1–11. DOI:10.1101/2020.04.26.20080911.

Key messages

- The high specificities (usually 100 %) reported in PCR-based tests for SARS-CoV-2 infection do not represent the real-world use of these tests, where contamination and human error produce significant rates of false positives.
- Widespread misunderstanding of these false positive rates affects an array of clinical, case management and health policy decisions. Similarly, health authorities' guidance on interpreting test results is often wrong.
- Steps should be taken immediately to reduce the frequency and impacts of false positive Results.

Unlike previous epidemics, in addressing COVID-19 nearly all international health organizations and national health ministries have treated a single positive result from a PCR-based test as confirmation of infection, even in asymptomatic persons without any history of exposure. This is based on a widespread belief that positive Results in these tests are highly reliable. However, data on PCR-based tests for similar viruses show that PCR-based testing produces enough false positive results to make positive results highly unreliable over a broad range of real-world scenarios. This has clinical and case management implications, and affects an array of epidemiological statistics, including the asymptomatic ratio, prevalence, and hospitalization and death rates. Steps should be taken to raise awareness of false positives, reduce their frequency, and mitigate their effects. In the interim, positive results in asymptomatic individuals that haven't been confirmed by a second test should be considered suspect.

DUQUE 2020

Daniel Duque, David P. Morton, Bismark Singh, Zhanwei Du, Remy Pasco & Lauren Ancel Meyers, *Timing social distancing to avert unmanageable COVID-19 hospital surges*. [PNAS](#) **117** (2020), 19873–19878. DOI:10.1073/pnas.2009033117.

[pnas117-19873-Supplement.pdf](#)

Following the April 16, 2020 release of the Opening Up America Again guidelines for relaxing coronavirus disease 2019 (COVID19) social distancing policies, local leaders are concerned about future pandemic waves and lack robust strategies for tracking and suppressing transmission. Here, we present a strategy for triggering short-term shelter-in-place orders when hospital admissions surpass a threshold. We use stochastic optimization to derive triggers that ensure hospital surges will not exceed local capacity and lockdowns are as short as possible. For example, Austin, Texas—the fastest-growing large city in the United States—has adopted a COVID-19 response strategy based on this method. Assuming that the relaxation of social distancing increases the risk of infection sixfold, the optimal strategy will trigger a total of 135 d (90 % prediction interval: 126 d to 141 d) of sheltering, allow schools to open in the fall, and result in an expected 2,929 deaths (90 % prediction interval: 2,837 to 3,026) by September 2021, which is 29 % of the annual mortality rate. In the months ahead, policy makers are likely to face difficult choices, and the extent of public restraint and cocooning of vulnerable populations may save or cost thousands of lives.

Keywords: COVID-19 | optimization | cocooning | social distancing | public health response

Significance: How can we best mitigate future pandemic waves while limiting collateral economic damage? As COVID-19 social distancing measures are relaxed across the United States, temporary shelter-in-place orders triggered by monitoring local hospital admissions can minimize the number of days of disruption while preventing overwhelming healthcare surges. We develop a mathematical optimization model on top of an SEIR-style simulation model with age group, risk group, and temporal fidelity. This work has been in response to independent requests from the city of Austin, the state of Texas, the Centers for Disease Control and Prevention, and the White House Coronavirus Task Force to inform strategies for modulating social distancing policies.

HAO 2020

Xingjie Hao, Shanshan Cheng, Degang Wu, Tangchun Wu, Xihong Lin & Chaolong Wang, *Reconstruction of the full transmission dynamics of COVID-19 in Wuhan*. *nature* **584** (2020), 420–424. DOI:10.1038/s41586-020-2554-8.

n584-0420-Supplement.pdf

As countries in the world review interventions for containing the pandemic of coronavirus disease 2019 (COVID-19), important lessons can be drawn from the study of the full transmission dynamics of its causative agent—severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)—in Wuhan (China), where vigorous non-pharmaceutical interventions have suppressed the local outbreak of this disease¹. Here we use a modelling approach to reconstruct the full-spectrum dynamics of COVID-19 in Wuhan between 1 January and 8 March 2020 across 5 periods defined by events and interventions, on the basis of 32,583 laboratory-confirmed cases¹. Accounting for presymptomatic infectiousness², time-varying ascertainment rates, transmission rates and population movements³, we identify two key features of the outbreak: high covertness and high transmissibility. We estimate 87 % (lower bound, 53 %) of the infections before 8 March 2020 were unascertained (potentially including asymptomatic and mildly symptomatic individuals); and a basic reproduction number (R_0) of 3.54 (95 % credible interval 3.40–3.67) in the early outbreak, much higher than that of severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS)^{4,5}. We observe that multipronged interventions had considerable positive effects on controlling the outbreak, decreasing the reproduction number to 0.28 (95 % credible interval 0.23–

0.33) and—by projection—reducing the total infections in Wuhan by 96.0 % as of 8 March 2020. We also explore the probability of resurgence following the lifting of all interventions after 14 consecutive days of no ascertained infections; we estimate this probability at 0.32 and 0.06 on the basis of models with 87 % and 53 % unascertained cases, respectively—highlighting the risk posed by substantial covert infections when changing control measures. These results have important implications when considering strategies of continuing surveillance and interventions to eventually contain outbreaks of COVID-19.

HELBERG 2020

Cristina Helberg, *Nein, aktuelle PCR-Tests haben keine Fehlerquote von 30 bis 50 Prozent.* correctiv.org 2020, Apr. 7. <<http://correctiv.org/faktencheck/medizin-und-gesundheit/2020/04/07/coronavirus>> (2020-08-18).

In mehreren Youtube-Videos wird behauptet, dass PCR-Tests zum Nachweis von Corona-Infektionen in 30 bis 50 Prozent der Fälle falsche Ergebnisse lieferten, weil sie zum Beispiel auf andere Viren reagierten. Das Ausmaß der Pandemie werde deshalb überschätzt. Der Virologe Christian Drosten hat den Aussagen bereits öffentlich widersprochen.

Auf die Frage von CORRECTIV, ob in deutschen Laboren, die Erfahrung mit PCR-Tests haben und Proben untersuchen, bei denen der Abstrich korrekt genommen wurde, eine Fehlerquote von 30 bis 50 Prozent falsch positiven Tests denkbar sei, antwortete er: “Nein, die RT-PCR sind hochspezifisch (Spezifität sicher im Bereich >95/98 %).”

HOLTZ 2020

David Holtz et al., *Interdependence and the cost of uncoordinated responses to COVID-19.* [PNAS](https://doi.org/10.1073/pnas.2009522117) **117** (2020), 19837–19843. DOI:10.1073/pnas.2009522117.

[pnas117-19837-Supplement.pdf](#)

Social distancing is the core policy response to coronavirus disease 2019 (COVID-19). But, as federal, state and local governments begin opening businesses and relaxing shelter-in-place orders worldwide, we lack quantitative evidence on how policies in one region affect mobility and social distancing in other regions and the consequences of uncoordinated regional policies adopted in the presence of such spillovers. To investigate this concern, we combined daily, county-level data on shelter-in-place policies with movement data from over 27 million mobile devices, social network connections among over 220 million Facebook users, daily temperature and precipitation data from 62,000 weather stations, and county-level census data on population demographics to estimate the geographic and social network spillovers created by regional policies across the United States. Our analysis shows that the contact patterns of people in a given region are significantly influenced by the policies and behaviors of people in other, sometimes distant, regions. When just one-third of a state’s social and geographic peer states adopt shelter-in-place policies, it creates a reduction in mobility equal to the state’s own policy decisions. These spillovers are mediated by peer travel and distancing behaviors in those states. A simple analytical model calibrated with our empirical estimates demonstrated that the “loss from anarchy” in uncoordinated state policies is increasing in the number of noncooperating states and the size of social and geographic spillovers. These results suggest a substantial cost of uncoordinated government responses to COVID-19 when people, ideas, and media move across borders.

Keywords: COVID-19 | peer effects | social spillovers | geographic spillovers

David Holtz, Michael Zhao, Seth G. Benzell,c, Cathy Y. Cao,b, Mohammad Amin Rahimian,d, Jeremy Yang, Jennifer Allen, Avinash Collis,e, Alex Moehring, Tara Sowrirajan,g, Dipayan Ghosh, Yunhao Zhang, Paramveer S. Dhillon,h, Christos Nicolaides,i, Dean Eckles & Sinan Aral

Significance: As local governments relax shelter-in-place orders worldwide, policy makers lack evidence on how policies in one region affect mobility and social distancing in other regions and the consequences of uncoordinated regional policies adopted in the presence of such spillovers. Our analysis suggests the contact patterns of people in one region are significantly influenced by the policies and behaviors of people in other, sometimes distant, regions. When just one-third of a state’s social and geographic peer states adopt shelter-in-place policies, it creates a reduction in mobility equal to the state’s own policy decisions, highlighting the need for national coordination. The paper gives governors a roadmap for coordination in the absence of national leadership and applies globally to other regions lacking coordination.

KATZ 2020

Andrew P. Katz et al., *False-positive reverse transcriptase polymerase chain reaction screening for SARS-CoV-2 in the setting of urgent head and neck surgery and otolaryngologic emergencies during the pandemic: Clinical implications.* *Head & Neck* **42** (2020), 1621–1628. DOI:10.1002/hed.26317.

Background: No reports describe falsepositive reverse transcriptase polymerase chain reaction (RT-PCR) for novel coronavirus in preoperative screening.

Methods: Preoperative patients had one or two nasopharyngeal swabs, depending on low or high risk of viral transmission. Positive tests were repeated.

Results: Forty-three of 52 patients required two or more preoperative tests. Four (9.3%) had discrepant results (positive/negative). One of these left the coronavirus disease (COVID) unit against medical advice despite an orbital abscess, with unknown true disease status. The remaining 3 of 42 (7.1%) had negative repeat RT-PCR. Although ultimately considered falsepositives, one was sent to a COVID unit postoperatively and two had urgent surgery delayed. Assuming negative repeat RT-PCR, clear chest imaging, and lack of subsequent symptoms represent the “gold standard,” RT-PCR specificity was 0.97.

Conclusions: If false positives are suspected, we recommend computed tomography (CT) of the chest and repeat RT-PCR. Validated serum immunoglobulin testing may ultimately prove useful.

Keywords: COVID-19 | head and neck surgery | pandemic | preoperative testing | RT-PCR

Andrew P. Katz, Francisco J. Civantos, Zoukaa Sargi, Jason M. Leibowitz, Elizabeth A. Nicolli, Donald Weed, Alexander E. Moskovitz, Alyssa M. Civantos, David M. Andrews, Octavio Martinez & Giovana R. Thomas

KVALSVIG 2020

Amanda Kvalsvig, *New Zealand races to eliminate the coronavirus — again.* *nature* **584** (2020), 336.

New Zealand had experienced more than 100 days with no identified community transmission, despite extensive testing.

All of the new cases seem to be part of the same cluster, but that hasn’t been linked back to its point of introduction into the country. That is concerning because we don’t yet know how long this outbreak has been propagating.

We know that elimination is possible because New Zealand eliminated community transmission before. We expect to move in and out of elimination for the foreseeable future. The goal is to maintain zero community spread but this country will always be under threat from infections being introduced through the borders.

LAVEZZO 2020

Enrico Lavezzo et al., *Suppression of a SARS-CoV-2 outbreak in the Italian municipality of Vo'*. *nature* **584** (2020), 425–429.

[DOI:10.1038/s41586-020-2488-1](https://doi.org/10.1038/s41586-020-2488-1).

[n584-0425-Supplement.pdf](#)

On 21 February 2020, a resident of the municipality of Vo', a small town near Padua (Italy), died of pneumonia due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection¹. This was the first coronavirus disease 19 (COVID-19)-related death detected in Italy since the detection of SARS-CoV-2 in the Chinese city of Wuhan, Hubei province². In response, the regional authorities imposed the lockdown of the whole municipality for 14 days³. Here we collected information on the demography, clinical presentation, hospitalization, contact network and the presence of SARS-CoV-2 infection in nasopharyngeal swabs for 85.9% and 71.5% of the population of Vo' at two consecutive time points. From the first survey, which was conducted around the time the town lockdown started, we found a prevalence of infection of 2.6% (95% confidence interval (CI): 2.1–3.3%). From the second survey, which was conducted at the end of the lockdown, we found a prevalence of 1.2% (95% CI: 0.8–1.8%). Notably, 42.5% (95% CI: 31.5–54.6%) of the confirmed SARS-CoV-2 infections detected across the two surveys were asymptomatic (that is, did not have symptoms at the time of swab testing and did not develop symptoms afterwards). The mean serial interval was 7.2 days (95% CI: 5.9–9.6). We found no statistically significant difference in the viral load of symptomatic versus asymptomatic infections ($P = 0.62$ and 0.74 for E and RdRp genes, respectively, exact Wilcoxon–Mann–Whitney test). This study sheds light on the frequency of asymptomatic SARS-CoV-2 infection, their infectivity (as measured by the viral load) and provides insights into its transmission dynamics and the efficacy of the implemented control measures.

Enrico Lavezzo, Elisa Franchin, Constanze Ciavarella, Gina Cuomo-Dannenburg, Luisa Barzon, Claudia Del Vecchio, Lucia Rossi, Riccardo Manganelli, Arianna Lorigian, Nicolò Navarin, Davide Abate, Manuela Sciro, Stefano Merigliano, Ettore De Canale, Maria Cristina Vanuzzo, Valeria Besutti, Francesca Saluzzo, Francesco Onelia, Monia Pacenti, Saverio G. Parisi, Giovanni Carretta, Daniele Donato, Luciano Flor, Silvia Cocchio, Giulia Masi, Alessandro Sperduti, Lorenzo Cattarino, Renato Salvador, Michele Nicoletti, Federico Caldart, Gioele Castelli, Eleonora Nieddu, Beatrice Labella, Ludovico Fava, Matteo Drigo, Katy A. M. Gaythorpe, Imperial College COV- Response Tea, Alessandra R. Brazzale, Stefano Toppo, Marta Trevisan, Vincenzo Baldo, Christl A. Donnelly, Neil M. Ferguson, Ilaria Dorigatti & Andrea Crisanti

LUCAS 2020

Carolina Lucas et al., *Longitudinal analyses reveal immunological misfiring in severe COVID-19*. *nature* **584** (2020), 463–469.

[DOI:10.1038/s41586-020-2588-y](https://doi.org/10.1038/s41586-020-2588-y).

[n584-0463-Supplement.xlsx](#)

Recent studies have provided insights into the pathogenesis of coronavirus disease 2019 (COVID-19)^{1–4}. However, the longitudinal immunological correlates of disease outcome remain unclear. Here we serially analysed immune responses in 113 patients with moderate or severe COVID-19. Immune profiling revealed an

overall increase in innate cell lineages, with a concomitant reduction in T cell number. An early elevation in cytokine levels was associated with worse disease outcomes. Following an early increase in cytokines, patients with moderate COVID-19 displayed a progressive reduction in type 1 (antiviral) and type 3 (antifungal) responses. By contrast, patients with severe COVID-19 maintained these elevated responses throughout the course of the disease. Moreover, severe COVID-19 was accompanied by an increase in multiple type 2 (anti-helminths) effectors, including interleukin-5 (IL-5), IL-13, immunoglobulin E and eosinophils. Unsupervised clustering analysis identified four immune signatures, representing growth factors (A), type-2/3 cytokines (B), mixed type-1/2/3 cytokines (C), and chemokines (D) that correlated with three distinct disease trajectories. The immune profiles of patients who recovered from moderate COVID-19 were enriched in tissue reparative growth factor signature A, whereas the profiles of those with who developed severe disease had elevated levels of all four signatures. Thus, we have identified a maladapted immune response profile associated with severe COVID-19 and poor clinical outcome, as well as early immune signatures that correlate with divergent disease trajectories.

Carolina Lucas, Patrick Wong, Jon Klein, Tiago B. R. Castro, Julio Silva, Maria Sundaram, Mallory K. Ellingson, Tianyang Mao, Ji Eun Oh, Benjamin Israelow, Takehiro Takahashi, Maria Tokuyama, Peiwen Lu, Arvind Venkataraman, Annsea Park, Subhasis Mohanty, Haowei Wang, Anne L. Wyllie, Chantal B. F. Vogels, Rebecca Earnest, Sarah Lapidus, Isabel M. Ott, Adam J. Moore, M. Catherine Muenker, John B. Fournier, Melissa Campbell, Camila D. Odio, Arnau Casanovas-Massana, Yale I. M. P. A. C. T. Tea, Roy Herbst, Albert C. Shaw, Ruslan Medzhitov, Wade L. Schulz, Nathan D. Grubaugh, Charles Dela Cruz, Shelli Farhadian, Albert I. Ko, Saad B. Omer & Akiko Iwasaki

PERLMAN 2020

Stanley Perlman, *COVID-19 poses a riddle for the immune system.* [nature](#) **584** (2020), 345–346.

It is unclear why people’s immune response to the SARS-CoV-2 coronavirus varies so widely. Tracking patient responses over time sheds light on this issue, and has implications for efforts to predict disease severity.

SERVICK 2020

Kelly Servick, *Coronavirus creates a flu season guessing game.* [science](#) **369** (2020), 890–891. DOI:10.1126/science.369.6506.890.

SARS-CoV-2’s interactions with other pathogens remain unknown as winter looms.

WEILL 2020

Joakim A. Weill, Matthieu Stiglerb, Olivier Deschenesc & Michael R. Springborn, *Social distancing responses to COVID-19 emergency declarations strongly differentiated by income.* [PNAS](#) **117** (2020), 19658–19660. DOI:10.1073/pnas.2009412117.

In the absence of a vaccine, social distancing measures are one of the primary tools to reduce the transmission of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, which causes coronavirus disease 2019 (COVID-19). We show that social distancing following US state-level emergency declarations substantially varies by income. Using mobility measures derived from mobile device location pings, we find that wealthier areas decreased mobility significantly more than poorer areas, and this general pattern holds across income

quantiles, data sources, and mobility measures. Using an event study design focusing on behavior subsequent to state emergency orders, we document a reversal in the ordering of social distancing by income: Wealthy areas went from most mobile before the pandemic to least mobile, while, for multiple measures, the poorest areas went from least mobile to most. Previous research has shown that lower income communities have higher levels of preexisting health conditions and lower access to healthcare. Combining this with our core finding—that lower income communities exhibit less social distancing—suggests a double burden of the COVID-19 pandemic with stark distributional implications.

Keywords: inequalities | COVID-19 | social distancing

Datierung

MANNING 2020

Sturt W. Manning et al., *Radiocarbon offsets and old world chronology as relevant to Mesopotamia, Egypt, Anatolia and Thera (Santorini)*. *Scientific Reports* **10** (2020), 13785. DOI:10.1038/s41598-020-69287-2.

The new IntCal radiocarbon record continues decades of successful practice by employing one calibration curve as an approximation for different regions across the hemisphere. Here we investigate three radiocarbon time-series of archaeological and historical importance from the Mediterranean-Anatolian region, which indicate, or may include, offsets from IntCal ($\approx -C$ years). While modest, these differences are critical for our precise understanding of historical and environmental events across the Mediterranean Basin and Near East. Offsets towards older radiocarbon ages in Mediterranean-Anatolian wood can be explained by a divergence between high-resolution radiocarbon dates from the recent generation of accelerator mass spectrometry (AMS) versus dates from previous technologies, such as low-level gas proportional counting (LLGPC) and liquid scintillation spectrometry (LSS). However, another reason is likely differing growing season lengths and timings, which would affect the seasonal cycle of atmospheric radiocarbon concentrations recorded in different geographic zones. Understanding and correcting these offsets is key to the well-defined calendar placement of a Middle Bronze Age tree-ring chronology. This in turn resolves longstanding debate over Mesopotamian chronology in the earlier second millennium BCE. Last but not least, accurate dating is needed for any further assessment of the societal and environmental impact of the Thera/Santorini volcanic eruption.

Sturt W. Manning, Lukas Wacker, Ulf Büntgen, Christopher Bronk Ramsey, Michael W. Dee, Bernd Kromer, Brita Lorentzen & Willy Tegel

Energie

CHO 2020

Adrian Cho, *Critics question whether novel reactor is ‘walk-away safe’*. *science* **369** (2020), 888–889.

Design approval nears for NuScale Power’s small modular reactors, but deployment plans slip 3 years.

It is also designed to shut itself down in a pinch. Each reactor fits within a steel containment vessel, which in turn sits in a pool of water holding up to a dozen modules. Ordinarily, the space between the reactor and containment vessel remains evacuated, like the vacuum jacket in a thermos bottle. Should the core overheat or the reactor leak, relief valves would vent steam into the evacuated space, where it

would conduct heat to the pool and condense into the bottom of the containment vessel. When enough water had accumulated, it would flow back into the reactor to keep the core safely submerged. NuScale is so confident in the design that it has asked NRC to allow its plants to run without the standard 32-kilometer-wide emergency planning zone.

LOPES 2020

Pietro P. Lopes & Vojislav R. Stamenkovic, *Past, present, and future of lead–acid batteries*. *science* **369** (2020), 923–924.

Improvements could increase energy density and enable power-grid storage applications.

Judentum

BERGER 1979

David Berger, *The Jewish-Christian debate in the high Middle Ages, A critical edition of the Nizzahon vetus with an introduction, translation, and commentary*. Judaica, Texts and Translations 4 (Philadelphia 1979).

HARNACK 1900

Adolf Harnack, *Das Wesen des Christentums, Sechzehn Vorlesungen vor Studierenden aller Facultäten im Wintersemester 1899/1900 an der Universität Berlin*. (Leipzig 1903).

Klima

CORRICK 2020

Ellen C. Corrick et al., *Synchronous timing of abrupt climate changes during the last glacial period*. *science* **369** (2020), 963–969.

s369-0963-Supplement0.pdf, s369-0963-Supplement1.pdf, s369-0963-Supplement2.pdf, s369-0963-Supplement3.pdf, s369-0963-Supplement4.txt, s369-0963-Supplement5.txt, s369-0963-Supplement6.xlsx, s369-0963-Supplement7.xlsx

Abrupt climate changes during the last glacial period have been detected in a global array of palaeoclimate records, but our understanding of their absolute timing and regional synchrony is incomplete. Our compilation of 63 published, independently dated speleothem records shows that abrupt warmings in Greenland were associated with synchronous climate changes across the Asian Monsoon, South American Monsoon, and European-Mediterranean regions that occurred within decades. Together with the demonstration of bipolar synchrony in atmospheric response, this provides independent evidence of synchronous high-latitude–to-tropical coupling of climate changes during these abrupt warmings. Our results provide a globally coherent framework with which to validate model simulations of abrupt climate change and to constrain ice-core chronologies.

Ellen C. Corrick, Russell N. Drysdale, John C. Hellstrom, Emilie Capron, Sune Olander Rasmussen, Xu Zhang, Dominik Fleitmann, Isabelle Couchoud & Eric Wolff

FREDERIKSE 2020

Thomas Frederikse et al., *The causes of sea-level rise since 1900*. [nature](#) **584** (2020), 393–397.

The rate of global-mean sea-level rise since 1900 has varied over time, but the contributing factors are still poorly understood¹. Previous assessments found that the summed contributions of ice-mass loss, terrestrial water storage and thermal expansion of the ocean could not be reconciled with observed changes in global-mean sea level, implying that changes in sea level or some contributions to those changes were poorly constrained^{2,3}. Recent improvements to observational data, our understanding of the main contributing processes to sea-level change and Methods for estimating the individual contributions, mean another attempt at reconciliation is warranted. Here we present a probabilistic framework to reconstruct sea level since 1900 using independent observations and their inherent uncertainties. The sum of the contributions to sea-level change from thermal expansion of the ocean, ice-mass loss and changes in terrestrial water storage is consistent with the trends and multidecadal variability in observed sea level on both global and basin scales, which we reconstruct from tide-gauge records. Ice-mass loss—predominantly from glaciers—has caused twice as much sea-level rise since 1900 as has thermal expansion. Mass loss from glaciers and the Greenland Ice Sheet explains the high rates of global sea-level rise during the 1940s, while a sharp increase in water impoundment by artificial reservoirs is the main cause of the lower-than-average rates during the 1970s. The acceleration in sea-level rise since the 1970s is caused by the combination of thermal expansion of the ocean and increased ice-mass loss from Greenland. Our results reconcile the magnitude of observed global-mean sea-level rise since 1900 with estimates based on the underlying processes, implying that no additional processes are required to explain the observed changes in sea level since 1900.

Thomas Frederikse, Felix Landerer, Lambert Caron, Surendra Adhikari, David Parkes, Vincent W. Humphrey, Sönke Dangendorf, Peter Hogarth, Laure Zanna, Lijing Cheng & Yun-Hao Wu

NEHRBASS-AHLES 2020

C. Nehrbass-Ahles & T. F. Stocker et al., *Abrupt CO₂ release to the atmosphere under glacial and early interglacial climate conditions*. [science](#) **369** (2020), 1000–1005.

s369-1000-Supplement0.pdf, s369-1000-Supplement1.xlsx, s369-1000-Supplement2.xlsx

Pulse-like carbon dioxide release to the atmosphere on centennial time scales has only been identified for the most recent glacial and deglacial periods and is thought to be absent during warmer climate conditions. Here, we present a high-resolution carbon dioxide record from 330,000 to 450,000 years before present, revealing pronounced carbon dioxide jumps (CDJ) under cold and warm climate conditions. CDJ come in two varieties that we attribute to invigoration or weakening of the Atlantic meridional overturning circulation (AMOC) and associated northward and southward shifts of the intertropical convergence zone, respectively. We find that CDJ are pervasive features of the carbon cycle that can occur during interglacial climate conditions if land ice masses are sufficiently extended to be able to disturb the AMOC by freshwater input.

C. Nehrbass-Ahles, J. Shin, J. Schmitt, B. Bereiter, F. Joos, A. Schilt, L. Schmidely, L. Silva, G. Teste, R. Grilli, J. Chappellaz, D. Hodell, H. Fischer & T. F. Stocker

Kupfer

MASON 2020

Andrea Mason, Wayne Powell, H. Arthur Bankoff, Ryan Mathur, Michael Price, Aleksandar Bulatović & Vojislav Filipović, *Provenance of tin in the Late Bronze Age balkans based on probabilistic and spatial analysis of Sn isotopes*. [Journal of Archaeological Science](#) **122** (2020), 105181, 1–13.

We report the largest published dataset to date of Sn-isotopic compositions of Bronze Age artifacts (338) along with 150 cassiterite samples (75 new) from six potential tin ore sources from which the tin in these artifacts were thought to have likely originated. The artifacts are from a broad area, Central Europe through the Central Balkans, and the six tin sources are Cornwall, three sites in the Erzgebirge, and two sites in Serbia. A clustering analysis on mean site-level isotopic values of $d_{124}\text{Sn}$ identifies regional variation that can be attributed to the use of different tin ore sources in different regions. Therefore, geographically meaningful regions were identified to group the Bronze Age artifact assemblages and a probabilistic, Bayesian analysis was performed to determine the proportional contribution of each tin source to each regional assemblage. Artifacts enriched in heavy isotopes ($d_{124}\text{Sn} > 0.7\text{‰}$) that cluster in west-central Serbia are likely associated with the ores from Mt. Cer in west Serbia. Mixed artifact assemblages (high and low $d_{124}\text{Sn}$) in this region are attributed to the use of cassiterite from the two Serbian sites (Mt. Cer and Mt. Bukulja). Moderate composition artifacts that occur north of the Middle Danube in Vojvodina, Transylvania, and Central Europe are likely associated primarily with ores from the West Pluton of the Erzgebirge. Compositionally light bronzes ($d_{124}\text{Sn} < 0.2\text{‰}$) in southern Serbia and the lower Danube river valley cannot be linked to a documented ore source. There is no indication of the use of ores from Cornwall or the East Pluton of the Erzgebirge in Central Europe and the Balkans during the Late Bronze Age.

Keywords: Provenance | Bronze | Tin isotopes | Bronze age | Archaeometallurgy | Probabilistic sourcing | Cassiterite

Metallzeiten

FILIPOVIĆ 2020

Dragana Filipović, John Meadows, Marta Dal Corso & Wiebke Kirleis et al., *New AMS ^{14}C dates track the arrival and spread of broom-corn millet cultivation and agricultural change in prehistoric Europe*. [Scientific Reports](#) **10** (2020), 13698. DOI:10.1038/s41598-020-70495-z.

SciRep10-13698-Supplement1.xlsx, SciRep10-13698-Supplement2.pdf, SciRep10-13698-Supplement3.pdf, SciRep10-13698-Supplement4.pdf, SciRep10-13698-Supplement5.pdf, SciRep10-13698-Supplement6.pdf, SciRep10-13698-Supplement7.pdf, SciRep10-13698-Supplement8.rtf

Broomcorn millet (*Panicum miliaceum* L.) is not one of the founder crops domesticated in Southwest Asia in the early Holocene, but was domesticated in northeast China by 6000 bc. In Europe, millet was reported in Early Neolithic contexts formed by 6000 bc, but recent radiocarbon dating of a dozen ‘early’ grains cast doubt on these claims. Archaeobotanical evidence reveals that millet was common in Europe from the 2nd millennium bc, when major societal and economic transformations took place in the Bronze Age. We conducted an extensive

programme of AMS-dating of charred broomcorn millet grains from 75 prehistoric sites in Europe. Our Bayesian model reveals that millet cultivation began in Europe at the earliest during the sixteenth century bc, and spread rapidly during the fifteenth/ fourteenth centuries bc. Broomcorn millet succeeds in an exceptionally wide range of growing conditions and completes its lifecycle in less than three summer months. Offering an additional harvest and thus surplus food/fodder, it likely was a transformative innovation in European prehistoric agriculture previously based mainly on (winter) cropping of wheat and barley. We provide a new, high-resolution chronological framework for this key agricultural development that likely contributed to far-reaching changes in lifestyle in late 2nd millennium bc Europe.

Dragana Filipović, John Meadows, Marta Dal Corso, Wiebke Kirleis, Almuth Alsleben, Örneker Akeret, Felix Bittmann, Giovanna Bosi, Beatrice Ciutã, Dagmar Dreslerová, Henrike Effenberger, Ferenc Gyulai, Andreas G. Heiss, Monika Hellmund, Susanne Jahns, Thorsten Jakobitsch, Magda Kapcia, Stefanie Kloß, Mari- anne Kohler-Schneider, Helmut Kroll, Przemysław Makarowicz, Elena Marinova, Tanja Märkle, Aleksandar Medoviæ, Anna Maria Mercuri, Aldona Mueller-Bieniek, Renato Nisbet, Galina Pashkevich, Renata Perego, Petr Pokorný, Łukasz Pospieszny, Marcin Przybyła, Kelly Reed, Joanna Rennwanz, Hans-Peter Stika, Astrid Stobbe, Tjaša Tolar, Krystyna Wasylkowa, Julian Wiethold & Tanja Zerl

Mittelalter

FUKS 2020

Daniel Fuks, Guy Bar-Oz, Yotam Tepper, Tali Erickson-Gini, Dafna Langgut, Lior Weissbrod & Ehud Weiss, *The rise and fall of viticulture in the Late Antique Negev Highlands reconstructed from archaeobotanical and ceramic data*. [PNAS 117 \(2020\), 19780–19791](#).

[pnas117-19780-Supplement1.pdf](#), [pnas117-19780-Supplement2.xlsx](#), [pnas117-19780-Supplement3.xlsx](#)

The international scope of the Mediterranean wine trade in Late Antiquity raises important questions concerning sustainability in an ancient international economy and offers a valuable historical precedent to modern globalization. Such questions involve the role of intercontinental commerce in maintaining sustainable production within important supply regions and the vulnerability of peripheral regions believed to have been especially sensitive to environmental and political disturbances. We provide archaeobotanical evidence from trash mounds at three sites in the central Negev Desert, Israel, unraveling the rise and fall of viticulture over the second to eighth centuries of the common era (CE). Using quantitative ceramic data obtained in the same archaeological contexts, we further investigate connections between Negev viticulture and circum-Mediterranean trade. Our findings demonstrate interrelated growth in viticulture and involvement in Mediterranean trade reaching what appears to be a commercial scale in the fourth to mid-sixth centuries. Following a mid-sixth century peak, decline of this system is evident in the mid- to late sixth century, nearly a century before the Islamic conquest. These findings closely correspond with other archaeological evidence for social, economic, and urban growth in the fourth century and decline centered on the mid-sixth century. Contracting markets were a likely proximate cause for the decline; possible triggers include climate change, plague, and wider sociopolitical developments. In long-term historical perspective, the unprecedented commercial florescence of the Late Antique Negev appears to have been unsustainable, reverting to an age-old pattern of smaller-scale settlement and survival–subsistence strategies within a time frame of about two centuries.

Keywords: Negev | Byzantine Empire | archaeobotany | protoglobalization | economic archaeology

Significance: Commercial production of luxury “Gaza wine” was long assumed to be the economic basis of Late Antique settlement in the Negev Desert. We present empirical evidence for local viticulture of scale and its connection to Mediterranean trade. Offering unprecedented testimony to the globalization of an ancient production economy in a marginal environment, our archaeobotanical and ceramic dataset illuminates the rise and fall of local viticulture in the fourth to sixth centuries of the common era (CE). Decline likely resulted from market contraction triggered by plague and climate change rather than Islamic conquest, exposing systemic vulnerabilities of Negev agricultural commercialization. In millennial-scale Negev history, the Late Antique commercial florescence is anomalous, lasting about two centuries before reverting to smaller settlement and survival–subsistence strategies.

Physik

MUSSER 2020

George Musser, *Paradox puts objectivity on shaky footing*. [science](#) **369** (2020), 889–890.

Quantum test of venerable thought experiment suggests facts are relative.

“It could be that there are facts for one observer, and facts for another; they need not mesh,” says study co-author and Griffith physicist Howard Wiseman. It is a radical relativism, still jarring to many. “From a classical perspective, what everyone sees is considered objective, independent of what anyone else sees,” says Olimpia Lombardi, a philosopher of physics at the University of Buenos Aires. And then there is Wigner’s verdict: that quantum mechanics itself breaks down.

Story or Book

GLAUSIUSZ 2020

Josie Glausiusz, *No dullards, these Neanderthals*. [nature](#) **584** (2020), 342–343.

Horse eyeballs, shell tools and bone hammers — Rebecca Wragg Sykes paints a vivid portrait of our adaptable ancient relatives.

Kindred: Neanderthal Life, Love, Death and Art. Rebecca Wragg Sykes. Bloomsbury Sigma (2020)