

**Cover image:** The *Drosophila* brain. Freshly minted copies of the protein CaMKII (a kinase important in memory) are tagged red, whereas the total population of the protein appears green. In the article on pages 7744–7749, Lin *et al.* describe a drug-activatable tag, dubbed “TimeSTAMP,” for labeling recently synthesized protein molecules. Image courtesy of Michael Z. Lin.

## From the Cover

- 7744 A protein time stamp
- 7658 High-pressure benzene
- 7774 Plankton diversity gradient
- 7791 Talking to T cells
- 7839 Notch rules mast cell fate

## Contents

### THIS WEEK IN PNAS

7625 In This Issue

### LETTERS (ONLINE ONLY)

- E27 **Natural selection does not explain cultural rates of change**  
John R. Skoyles
- E28 **Reply to Skoyles: Natural selection does appear to explain some cultural rates of change**  
Deborah S. Rogers and Paul R. Ehrlich
- E29 **Reply to Bagni: On BC1 RNA and the fragile X mental retardation protein**  
Anna Iacoangeli, Timofey S. Rozhdestvensky, Natalia Dolzhanskaya, Barthélémy Tournier, Janin Schütt, Jürgen Brosius, Robert B. Denman, Edouard W. Khandjian, Stefan Kindler, and Henri Tiedge

### COMMENTARIES

- 7627 **Muscle insulin resistance: A case of fat overconsumption, not mitochondrial dysfunction**  
Edward W. Kraegen, Gregory J. Cooney, and Nigel Turner  
→ See companion article on page 7815



Free online through the PNAS open access option.

- 7629 **Notch2 paves the way to mast cells by Hes1 and Gata3**  
Priya Dedhia, Taku Kambayashi, and Warren S. Pear  
→ See companion article on page 7839

### PHYSICAL SCIENCES

#### APPLIED MATHEMATICS

- 7631 **Inflationary dynamics for matrix eigenvalue problems**  
Eric J. Heller, Lev Kaplan, and Frank Pollmann

#### APPLIED PHYSICAL SCIENCES

- 7636 **Passivation of irregular surfaces accessed by diffusion**  
M. Filoche, D. S. Grebenkov, J. S. Andrade, Jr., and B. Sapoval

#### CHEMISTRY

- 7641 **Controlling the efficiency of an artificial light-harvesting complex**  
Janne Savolainen, Riccardo Fanciulli, Niels Dijkhuizen, Ana L. Moore, Jürgen Hauer, Tiago Buckup, Marcus Motzkus, and Jennifer L. Herek
- 7647 **Lithium monoxide anion: A ground-state triplet with the strongest base to date**  
Zhixin Tian, Bun Chan, Michael B. Sullivan, Leo Radom, and Steven R. Kass
- 7652 **Thiolate-bridged dinuclear iron(tris-carbonyl)-nickel complexes relevant to the active site of [NiFe] hydrogenase**  
Yasuhiro Ohki, Kazunari Yasumura, Katsuaki Kuge, Soichiro Tanino, Masaru Ando, Zilong Li, and Kazuyuki Tatsumi

- 7658 **Role of excited electronic states in the high-pressure amorphization of benzene**  
Margherita Citroni, Roberto Bini, Paolo Foggi, and Vincenzo Schettino

#### ENGINEERING

- 7791 **Micropatterning of costimulatory ligands enhances CD4<sup>+</sup> T cell function**  
Keyue Shen, V. Kaye Thomas, Michael L. Dustin, and Lance C. Kam

#### ENVIRONMENTAL SCIENCES

- 7664 **Impact of geoengineering schemes on the global hydrological cycle**  
G. Bala, P. B. Duffy, and K. E. Taylor

### BIOLOGICAL SCIENCES

#### AGRICULTURAL SCIENCES

- 7670 **Acid sphingomyelinase involvement in tumor necrosis factor  $\alpha$ -regulated vascular and steroid disruption during luteolysis *in vivo***  
Luiz E. Henkes, Brian T. Sullivan, Maureen P. Lynch, Richard Kolesnick, Danielle Arsenault, Mark Puder, John S. Davis, and Bo R. Rueda

#### ANTHROPOLOGY

- 7676 **Dating the late prehistoric dispersal of Polynesians to New Zealand using the commensal Pacific rat**  
Janet M. Wilmshurst, Atholl J. Anderson, Thomas F. G. Higham, and Trevor H. Worthy

#### BIOCHEMISTRY

- 7681 **Contacts between membrane proximal regions of the PDGF receptor ectodomain are required for receptor activation but not for receptor dimerization**  
Yan Yang, Satoru Yuzawa, and Joseph Schlessinger
- 7687 **ALIX-CHMP4 interactions in the human ESCRT pathway**  
John McCullough, Robert D. Fisher, Frank G. Whitby, Wesley I. Sundquist, and Christopher P. Hill
- 7692 **Dimeric subunit stoichiometry of the human voltage-dependent proton channel Hv1**  
Seok-Yong Lee, James A. Letts, and Roderick MacKinnon
- 7696 **Insights into the stator assembly of the *Vibrio* flagellar motor from the crystal structure of MotY**  
Seiji Kojima, Akari Shinohara, Hiroyuki Terashima, Toshiharu Yakushi, Mayuko Sakuma, Michio Homma, Keiichi Namba, and Katsumi Imada
- 7702 **Interplay of PDZ and protease domain of DegP ensures efficient elimination of misfolded proteins**  
Tobias Krojer, Karen Pangerl, Juliane Kurt, Justyna Sawa, Christoph Stingl, Karl Mechtler, Robert Huber, Michael Ehrmann, and Tim Clausen

#### BIOPHYSICS

- 7641 **Controlling the efficiency of an artificial light-harvesting complex**  
Janne Savolainen, Riccardo Fanciulli, Niels Dijkhuizen, Ana L. Moore, Jürgen Hauer, Tiago Buckup, Marcus Motzkus, and Jennifer L. Herek

- 7708 **Coevolution at protein complex interfaces can be detected by the complementarity trace with important impact for predictive docking**  
Hocine Madaoui and Raphaël Guerois

- 7714 **Load-dependent ADP binding to myosins V and VI: Implications for subunit coordination and function**  
Yusuke Oguchi, Sergey V. Mikhailenko, Takashi Ohki, Adrian O. Olivares, Enrique M. De La Cruz, and Shin'ichi Ishiwata

- 7720 **Two-dimensional infrared spectra of isotopically diluted amyloid fibrils from A $\beta$ 40**  
Yung Sam Kim, Liu Liu, Paul H. Axelsen, and Robin M. Hochstrasser

- 7726 **Electrostatic basis for the unidirectionality of the primary proton transfer in cytochrome c oxidase**  
Andrei V. Pislakov, Pankaz K. Sharma, Zhen T. Chu, Maciej Haranczyk, and Arieh Warshel

#### CELL BIOLOGY

- 7732 **Asymmetric mitosis: Unequal segregation of proteins destined for degradation**  
Luis C. Fuentealba, Edward Eivers, Douglas Geissert, Vincent Taelman, and E. M. De Robertis

- 7738 **Control of endothelial cell proliferation and migration by VEGF signaling to histone deacetylase 7**  
Shusheng Wang, Xiumin Li, Maribel Parra, Eric Verdin, Rhonda Bassel-Duby, and Eric N. Olson

- 7744 **A drug-controllable tag for visualizing newly synthesized proteins in cells and whole animals**  
Michael Z. Lin, Jeffrey S. Glenn, and Roger Y. Tsien

#### DEVELOPMENTAL BIOLOGY

- 7750 **A nonneural epithelial domain of embryonic cranial neural folds gives rise to ectomesenchyme**  
Marie Anne Breau, Thomas Pietri, Marc P. Stemmler, Jean Paul Thiery, and James A. Weston
- 7756 ***Cdx* gene deficiency compromises embryonic hematopoiesis in the mouse**  
Yuan Wang, Akiko Yabuuchi, Shannon McKinney-Freeman, Danica M. K. Ducharme, Manas K. Ray, Kallayane Chawengsaksophak, Trevor K. Archer, and George Q. Daley
- 7762 **Promoter elements associated with RNA Pol II stalling in the *Drosophila* embryo**  
David A. Hendrix, Joung-Woo Hong, Julia Zeitlinger, Daniel S. Rokhsar, and Michael S. Levine

#### ECOLOGY

- 7768 **Spatial scaling of functional gene diversity across various microbial taxa**  
Jizhong Zhou, Sanghoon Kang, Christopher W. Schadt, and Charles T. Garten, Jr.

- 7774 **A latitudinal diversity gradient in planktonic marine bacteria**  
Jed A. Fuhrman, Joshua A. Steele, Ian Hewson, Michael S. Schwalbach, Mark V. Brown, Jessica L. Green, and James H. Brown

## EVOLUTION

- 7779 **Natural variation in *Pristionchus pacificus* insect pheromone attraction involves the protein kinase EGL-4**  
Ray L. Hong, Hanh Witte, and Ralf J. Sommer

## GENETICS

- 7785 **p53 stabilization in response to DNA damage requires Akt/PKB and DNA-PK**  
Karen A. Boehme, Roman Kulikov, and Christine Blattner

## IMMUNOLOGY

- 7791 **Micropatterning of costimulatory ligands enhances CD4<sup>+</sup> T cell function**  
Keyue Shen, V. Kaye Thomas, Michael L. Dustin, and Lance C. Kam
- 7797 **T cell receptor signaling controls Foxp3 expression via PI3K, Akt, and mTOR**  
Stephan Sauer, Ludovica Bruno, Arnulf Hertweck, David Finlay, Marion Leleu, Mikhail Spivakov, Zachary A. Knight, Bradley S. Cobb, Doreen Cantrell, Eric O'Connor, Kevan M. Shokat, Amanda G. Fisher, and Matthias Merkenschlager
- 7803 **A NOD2–NALP1 complex mediates caspase-1-dependent IL-1 $\beta$  secretion in response to *Bacillus anthracis* infection and muramyl dipeptide**  
Li-Chung Hsu, Syed R. Ali, Shauna McGillivray, Ping-Hui Tseng, Sanjeev Mariathasan, Eric W. Humke, Lars Eckmann, Jonathan J. Powell, Victor Nizet, Vishva M. Dixit, and Michael Karin

## MEDICAL SCIENCES

- 7809 **Modulation of TNF- $\alpha$ -converting enzyme by the spike protein of SARS-CoV and ACE2 induces TNF- $\alpha$  production and facilitates viral entry**  
Shiori Haga, Norio Yamamoto, Chikako Nakai-Murakami, Yoshiaki Osawa, Kenzo Tokunaga, Tetsutaro Sata, Naoki Yamamoto, Takehiko Sasazuki, and Yukihito Ishizaka
- 7815 **High-fat diets cause insulin resistance despite an increase in muscle mitochondria**  
Chad R. Hancock, Dong-Ho Han, May Chen, Shin Terada, Toshihiro Yasuda, David C. Wright, and John O. Holloszy  
→ See Commentary on page 7627
- 7821 **Involvement of estrogen-related receptors in transcriptional response to hypoxia and growth of solid tumors**  
Ada Ao, Heiman Wang, Sushama Kamarajugadda, and Jianrong Lu
- 7827 **Next generation of adeno-associated virus 2 vectors: Point mutations in tyrosines lead to high-efficiency transduction at lower doses**  
Li Zhong, Baozheng Li, Cathryn S. Mah, Lakshmanan Govindasamy, Mavis Agbandje-McKenna, Mario Cooper, Roland W. Herzog, Irene Zolotukhin, Kenneth H. Warrington, Jr., Kirsten A. Weigel-Van Aken, Jacqueline A. Hobbs, Sergei Zolotukhin, Nicholas Muzyczka, and Arun Srivastava
- 7833 **Cidea is associated with lipid droplets and insulin sensitivity in humans**  
Vishwajeet Puri, Srijana Ranjit, Silvana Konda, Sarah M. C. Nicoloso, Juerg Straubhaar, Anil Chawla, My Chouinard, Chenyi Lin, Alison Burkart, Silvia Corvera, Richard A. Perugini, and Michael P. Czech

- 7839 **Coordinated regulation of transcription factors through *Notch2* is an important mediator of mast cell fate**  
Mamiko Sakata-Yanagimoto, Etsuko Nakagami-Yamaguchi, Toshiki Saito, Keiki Kumano, Koji Yasutomo, Seishi Ogawa, Mineo Kurokawa, and Shigeru Chiba  
→ See Commentary on page 7629

## MICROBIOLOGY

- 7845 **Immunity to a salivary protein of a sand fly vector protects against the fatal outcome of visceral leishmaniasis in a hamster model**  
Regis Gomes, Clarissa Teixeira, Maria Jânia Teixeira, Fabiano Oliveira, Maria José Menezes, Claire Silva, Camila I. de Oliveira, Jose C. Miranda, Dia-Eldin Elnaem, Shaden Kamhawi, Jesus G. Valenzuela, and Cláudia I. Brodskyn
- 7851 **A dicarboxylate/4-hydroxybutyrate autotrophic carbon assimilation cycle in the hyperthermophilic *Archaeum ignicoccus hospitalis***  
Harald Huber, Martin Gallenberger, Ulrike Jahn, Eva Eylert, Ivan A. Berg, Daniel Kockelkorn, Wolfgang Eisenreich, and Georg Fuchs
- 7857 **Population structure of the genes encoding the polymorphic *Plasmodium falciparum* apical membrane antigen 1: Implications for vaccine design**  
Junhui Duan, Jianbing Mu, Mahamadou Ali Thera, Deirdre Joy, Sergei L. Kosakovsky Pond, David Diemert, Carole Long, Hong Zhou, Kazutoyo Miura, Amed Ouattara, Amagana Dolo, Ogobara Doumbo, Xin-zhuan Su, and Louis Miller

## NEUROSCIENCE

- 7863 **Place cell firing correlates with memory deficits and amyloid plaque burden in Tg2576 Alzheimer mouse model**  
Francesca Cacucci, Ming Yi, Thomas J. Wills, Paul Chapman, and John O'Keefe
- 7869 **Functional significance of axonal Kv7 channels in hippocampal pyramidal neurons**  
Mala M. Shah, Michele Migliore, Ignacio Valencia, Edward C. Cooper, and David A. Brown
- 7875 **Complexins facilitate neurotransmitter release at excitatory and inhibitory synapses in mammalian central nervous system**  
Mingshan Xue, Alicja Stradomska, Hongmei Chen, Nils Brose, Weiqi Zhang, Christian Rosenmund, and Kerstin Reim

## PLANT BIOLOGY

- 7881 **An original adaptation of photosynthesis in the marine green alga *Ostreococcus***  
Pierre Cardol, Benjamin Bailleul, Fabrice Rappaport, Evelyne Derelle, Daniel Béal, Cécile Breyton, Shaun Bailey, Francis André Wollman, Arthur Grossman, Hervé Moreau, and Giovanni Finazzi
- 7887 **Independent origins of syringyl lignin in vascular plants**  
Jing-Ke Weng, Xu Li, Jake Stout, and Clint Chapple

## MEDICAL SCIENCES

- 7893 **A  $\beta$ -oxidation-resistant lipoxin A<sub>4</sub> analog treats hapten-induced colitis by attenuating inflammation and immune dysfunction**

Stefano Fiorucci, John L. Wallace, Andrea Mencarelli, Eleonora Distrutti, Giovanni Rizzo, Silvana Farneti, Antonio Morelli, Jih-Lie Tseng, Babu Suramanyam, William J. Guilford, and John F. Parkinson

## PHARMACOLOGY

- 7893 **NCX-1015, a nitric-oxide derivative of prednisolone, enhances regulatory T cells in the lamina propria and protects against 2,4,6-trinitrobenzene sulfonic acid-induced colitis in mice**

Stefano Fiorucci, Elisabetta Antonelli, Eleonora Distrutti, Piero Del Soldato, Roderick J. Flower, Mark J. Paul Clark, Antonio Morelli, Mauro Perretti, and Louis J. Ignarro

## PHYSIOLOGY

- 7893 **NCX-1000, a NO-releasing derivative of ursodeoxycholic acid, selectively delivers NO to the liver and protects against development of portal hypertension**

Stefano Fiorucci, Elisabetta Antonelli, Olivia Morelli, Andrea Mencarelli, Alessandro Casini, Tommaso Mello, Barbara Palazzetti, Dominique Tallet, Piero del Soldato, and Antonio Morelli

## NEUROSCIENCE

- 7893 **Organization of the core structure of the postsynaptic density**

Xiaobing Chen, Christine Winters, Rita Azzam, Xiang Li, James A. Galbraith, Richard D. Leapman, and Thomas S. Reese

## PLANT BIOLOGY

- 7893 **Salt tolerance of *Arabidopsis thaliana* requires maturation of N-glycosylated proteins in the Golgi apparatus**

Jae Sook Kang, Julia Frank, Chang Ho Kang, Hiroyuki Kajiura, Meenu Vikram, Akihiro Ueda, Sewon Kim, Jeong Dong Bahk, Barbara Triplett, Kazuhito Fujiyama, Sang Yeol Lee, Antje von Schaewen, and Hisashi Koiwa

xi–xii Author Index

xiii Subscription Form