

JOURNAL of PALEONTOLOGY



VOL 94 | NO 6 | NOVEMBER 2020



CAMBRIDGE
UNIVERSITY PRESS



OFFICERS AND EDITORS OF THE PALEONTOLOGICAL SOCIETY



President
BRUCE MacFADDEN,
Florida Museum of Natural History
bmacfadd@flmnh.ufl.edu

President-Elect
WILLIAM A. DiMICHELE,
Smithsonian Institution
dimichel@si.edu

Past President
ARNOLD I. MILLER,
Univ. of Cincinnati
Arnold.miller@uc.edu

Secretary
CLAUDIA JOHNSON,
Indiana Univ.
claudia@indiana.edu

Treasurer
ALYCIA STIGALL,
Ohio Univ.
stigall@ohio.edu

JP Editors
BRENDA R. HUNDA,
Cincinnati Museum Center
BHunda@cincymuseum.org

JISUO JIN,
Univ. of Western Ontario
jjin@uwo.ca

HANS-DIETER SUES,
Smithsonian Institution
suesh@si.edu

ELLEN CURRANO,
Univ. of Wyoming
ecurrano@uwyo.edu

JP Associate Editors
JOSEPH BOTTING,
Nanjing Institute of Geology
and Paleontology,
Chinese Academy of Sciences

STYLIANOS CHATZIMANOLIS,
Univ. Tennessee–Chattanooga

TOM CRONIN,
U.S. Geological Survey

WILLIAM A. DiMICHELE,
Smithsonian Institution

JAN OVE EBBESTAD
Museum of Evolution,
Uppsala Univ.

ROBERT J. ELIAS,
Univ. of Manitoba

NADIA FRÖBISCH,
Museum für Naturkunde

PETER J. HARRIES,
North Carolina State

MICHAEL HAUTMANN,
Univ. of Zurich

MARTIN J. HEAD,
Brock Univ.

THOMAS HEGNA,
Western Illinois Univ.

SAMANTHA HOPKINS,
Univ. of Oregon

NIGEL HUGHES
Univ. of California

NATHAN JUD,
Univ. of Florida

MICHAEL KAMINSKI
King Fahd University of Petroleum and
Minerals

DANIEL KSEPKA,
Bruce Museum

JAMES LAMSDSELL,
West Virginia Univ.

MAX LANGER,
Universidade de São Paulo

BERTRAND LEFEBVRE,
Lyon Univ.

STEPHEN A. LESLIE,
James Madison Univ.

BRUCE LIEBERMAN,
Univ. of Kansas

ALEX LIU,
Univ. of Cambridge

STEVEN LoDUCA,
Eastern Michigan Univ.

RICK LUPIA,
Univ. of Oklahoma

GABRIELA MÁNGANO,
Univ. of Saskatchewan

GREG McDONALD,
Bureau of Land Management

RICHARD MOOI,
California Academy of Sciences

ALISON MURRAY,
Univ. of Alberta

PAULA NOBLE,
Univ. of Nevada

ANDRZEJ PISERA,
Polish Academy of Sciences

BRIAN PRATT,
Univ. of Saskatchewan

SIMON SCHNEIDER,
CASP

CRAIG SCOTT,
Royal Tyrrell Museum of Paleontology

MARY SILCOX,
Univ. of Toronto Scarborough

EDUARDO LEORRI SORIANO,
East Carolina Univ., Greenville

COLIN SPROAT
Univ. of Saskatchewan

DAVID VARRICCHIO,
Montana State Univ.

STEVE WESTROP,
Oklahoma Museum

DAVID M. WORK,
Maine State Museum

MARGARET M. YACOBUCCI,
Bowling Green State Univ.

SAMUEL ZAMORA,
Geological Survey of Spain

RENBIN ZHAN,
Nanjing Institute of Geology and
Palaeontology,
Chinese Academy of Sciences

SHUNXIN ZHANG,
Canada–Nunavut Geoscience Office

ZHIFEI ZHANG,
Northwest Univ.

Paleobiology Senior Editor
MARK PATZKOWSKY,
Penn State Univ.

Paleobiology Co-Editors
NADIA FRÖBISCH,
Museum für Naturkunde

KEVIN BOYCE,
Stanford Univ.

WOLFGANG KIESSLING,
Universitat Erlangen

JAMES CRAMPTON,
GNA Science

Managing Editor
JESSICA KASTIGAR,
JournalofPaleontology@cambridge.org
Paleobiology@cambridge.org

Communications Officer
TAORMINA LEPÖRE,
Univ. of California, Berkeley
tlepore@berkeley.edu

Program Coordinator
MATTHEW CLAPHAM,
Univ. of California, Santa Cruz
mclapham@ucsc.edu

Editor, Special Publications
COLIN SUMRALL,
Univ. of Tennessee, Knoxville
csumrall@utk.edu

Education/Outreach Coordinator
ROWAN LOCKWOOD,
College of William & Mary
rxlock@wm.edu

Diversity and Inclusion Coordinator
DENA SMITH,
Univ. of Colorado
dena.smith@colorado.edu

Amateur/Avocational Liaison
LINDA McCALL,
lndmccall02@yahoo.com

Representatives At Large
GABRIELA MÁNGANO,
Univ. of Saskatchewan
gabriela.mangano@usask.ca

PHOEBE COHEN,
Williams College
pac3@williams.edu

Student Representative
BRIDGET KELLY,
Univ. of California, Riverside
bkell006@ucr.edu

ANNAKA CLEMENT,
North Dakota State Univ.
annaka.clement@ndsu.edu

Section Chairs
Cordilleran:
CARLIE PIETSCH,
San Jose State Univ.
carlie.pietsch@sjsu.edu

North Central:
CARRIE SCHWEITZER,
Kent State Univ.
cschweit@kent.edu

Northeastern:
JACALYN WITTMER
MALINOWSKI,
SUNY Geneseo
malinowski@geneseo.edu

Rocky Mountain:
BROOKE LONG-FOX,
S. Dakota School of Mines & Tech.
brooke.long@mines.sdsmt.edu

South Central:
VICTORIA CHRAIBI,
Tarleton State Univ.
chraibi@tarleton.edu

Southeastern:
TOM TOBIN,
Univ. of Alabama
ttobin@ua.edu

Cover illustration: Plan view of *Dickinsonia cf. D. menneri* from the Ust-Pinega Formation, Late Vendian, Southeastern White Sea area. Ivantsov et al., Fig. 4.1.

ISSN 0022-3360

Copyright © 2020 The Paleontological Society. All rights reserved.

SUBSCRIPTION INFORMATION

The Journal of Paleontology [ISSN 0022-3360] is published bimonthly (January, March, May, July, September, and November) by Cambridge University Press (One Liberty Plaza, 20th Floor, New York, NY 10006) for the Paleontological Society. Members of the Paleontological Society automatically receive electronic subscriptions to the *Journal of Paleontology* and *Paleobiology* as a benefit of membership. Institutional subscriptions can be purchased direct from Cambridge University Press or through any major subscription agent. Print-only, online-only, and bundled print and online prices are all available, and subscription prices are tiered according to institution type and size.

Please contact Cambridge University Press for further details:

For customers in North America

Email: subscriptions_newyork@cambridge.org; Phone: (800) 872-7423, option 4

For customers outside of North America

Email: journals@cambridge.org;

Phone: +44 (0)1223-32-6070; Fax: +44 (0)1223-32-5150

Downloads of individual articles are available on <https://www.cambridge.org/core/journals/journal-of-paleontology>.

Reprints of individual articles may be ordered. For information on reprints, please contact Cambridge University Press.

Archives of previous issues are available on <https://www.cambridge.org/core/journals/journal-of-paleontology>.

Permissions All rights reserved. Permissions and reproduction policies, request forms, and contacts are available at: <http://www.cambridge.org/about-us/rights-permissions/>

ADVERTISING

To advertise in the journal please contact M. J. Mrvica Associates, 2 West Taunton Avenue, Berlin, NJ 08009; Phone: 856-768-9360; Fax: 856-753-0064; Email: mjmrvica@mrvica.com

ABSTRACTING AND INDEXING

Abstracting and indexing information for the *Journal of Paleontology* is available at: <https://www.cambridge.org/core/journals/journal-of-paleontology/information/abstracting-and-indexing>.

POSTAL INFORMATION

Periodicals postage rate paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes in the USA, Canada, and Mexico to: *Journal of Paleontology*, Cambridge University Press, Journals Fulfillment Department, One Liberty Plaza, 20th Floor, New York, NY 10006. Send address changes elsewhere to the *Journal of Paleontology*, Cambridge University Press, Journals Fulfillment Department, UPH, Shaftesbury Road, Cambridge CB2 8BS, England.

Copyright © 2020 The Paleontological Society. All rights reserved.

Printed in the United States of America

Rubén Molina-Pérez & Asier Larramendi

Dinosaur

Facts and Figures

The Theropods
and Other Dinosauriformes



Illustrated by Andrey Atuchin & Sante Mazzei

An illustrated record book of sauropod facts and figures—the hugest, the oldest, the most intelligent, and more

- Features a wealth of comparative records
- Includes more than 2,000 diagrams and technical drawings and hundreds of full-color reconstructions
- Covers all known sauropodomorph species
- Provides listings of footprints, biometric specifications, and scholarly and popular references

 PRINCETON
UNIVERSITY
PRESS