Laterite and Landscape

M.J.McFarlane Formerly Department of Geography University of Nairobi Nairobi, Kenya

Tropical geomorphology is a relatively new and rapidly expanding area of study. Thus laterite has only recently been studied as the end-product of a specific tropical weathering process rather than as a pedological entity. The aim of this book is both to present existing information on the geomorphological aspects of laterite, and to broaden the environmental approach, encouraging geologists and geomorphologists to tackle an area of great practical importance for conservation in the Tropics. The author reviews the relationship between laterite genesis and landscape development, emphasizing the environment of formation - geology, topography, climate, vegetation and profile-and proposing a model associating laterite

January 1977, xiv+152pp., £5.80/\$ 12.75 0.12.484450.2

development with landsurface reduction. The book should appeal to geomorphologists, geographers, geologists and environmentalists alike.

Contents

A historical review of theories of laterite genesis. What is laterite? The environment of laterite laterite and geology. The environment of laterite —laterite and topography. The environment of laterite—laterite and climate. The environment of laterite—laterite and vegetation. The environment and laterite—laterite and the profile. Plate section. Laterite structures. The chemical constituents of laterites: their mobility and relevance to the study of laterite genesis. Laterite genesis. Laterite and the denudation chronology of Uganda. References. Subject index.

Foraminifera Volume 2

edited by R.H. Hedley British Museum (Natural History) London, England and C.G. Adams British Museum (Natural History) London, England

This is the second volume in an open-ended series containing review articles on various aspects of foraminiferal research including biogeography, biometrics, cytology, ecology, oceanography, sedimentology, stratigraphy and systematics.

In this volume the contributors, all experts in their fields, discuss oxygen isotope studies as applied to foraminifera, the analysis of living and dead foraminiferal assemblages, phenotypic variation in Recent planktonic foraminifera, and the composition and distribution of Recent faunas from the South American region.

The series will be of special relevance to industrial and academic palaeontologists, to ecologists, biologists and oceanographers.

Academic Press

January 1977, x + 260pp., £10.50/\$ 23.00 0.12.336402.7

Contents

Alan D. Hecht: The oxygen isotopic record of foraminifera in deep sea sediment John W. Murray. Comparative studies in living and dead benthic foraminiferal distribution James P. Kennett: Phenotypic variation in some Recent and Late Cenozoic planktonic foraminifera

Esteban Boltovskoy: Distribution of Recent foraminifera of the South American region Ruth Todd: Joseph Augustine Cushman, 1881–1949: a biographical sketch Systematic index Subject index

Volume 1 edited by R.H. Hedley and C.G. Adams

1974, x + 276pp., £7.60/\$ 17.25 0.12.336401.9

London

New York San Francisco



A Subsidiary of Harcourt Brace Jovanovich Publishers

24-28 Oval Road, London NW1, England 111 Fifth Avenue, New York, NY 10003, USA Australian office: PO Box 300, North Ryde, NSW 2113, Australia

Geological Magazine, 114, 6

(i)

Oceanic Micropalaeontology edited by A. T. S. Ramsay

Volume 1

September/October 1977, xii+838pp; £42.50/\$87.00 0.12.577301.3

Volume 2

October/November 1977, xii+680pp., £36.00/\$70.25 0.12.577302.1

The micropalaeontological investigation of oceanic sediments has become an exciting and rapidly-expanding field of palaeontological research. It involves new concepts in marine geology; new schemes of biostratigraphical zonation, and the climatic and oceanographic history of the Earth since the Mesozoic. The papers in these volumes present a review of established knowledge and of recent developments in many important aspects of oceanic micropalaeontology.

Contents of Volume 1

Allan W. H. Bé: An ecological, zoogeographic and taxonomic review of recent planktonic foraminifera. W. F. Ruddiman: Investigations of quaternary climate based on planktonic foraminifera. William N. Orr and D. Graham Jenkins: Cainozoic planktonic foraminifera zonation and selective test solution. W. A. Berggren: Atlas of palaeogene planktonic foraminifera. Some species of the genera, *Subbotina, Planorotalites, Morozovella, Acarinina* and *Truncorotaloides*. Bruce A. Masters: Mesozoic planktonic foraminifera. A world-wide review and analysis. Allan W. H. Bé and Ronald W. Gilmer: A zoogeographic and taxonomic review of euthecosomatous pteropoda. General index. Taxonomic index.

Contents of Volume 2

Richard E. Casey: The ecology and distribution of recent radiolaria. W. R. Riedel and Annika Sanfilippo: Cainozoic radiolaria. Emile A. Pessagno, Jr.: Radiolaria in Mesozoic stratigraphy. Susumu Honjo: Biogeography and provincialism of living coccolithophorids in the Pacific Ocean. Kurt R. Geltzenauer, Michael B. Roche and Andrew McIntyre: Coccolith biogeography from North Atlantic and Pacific surface sediments. Nahum Schneidermann: Selective dissolution of recent coccoliths in the Atlantic Ocean. William W. Hay: Calcareous nannofossils. Thomas R. Worsley and Maurice L. Jorgens: Automated biostratigraphy. Graham L. Williams: Dinocysts. E. Martini: Systematics, distribution and stratigraphical application of silico-flagellates. Jan Van Donk: O¹⁸ as a tool for micropalaeontologists. A. T. S. Ramsay: Fluctuations in the calcite condensation depth and changes in hiatus abundance and distribution patterns as palaeo-oceanographic indicators. General Index. Taxonomic index.

Academic Press

London New York San Francisco

A subsidiary of Harcourt Brace Jovanovich, Publishers 24–28 Oval Road, London NW1, England 111 Fifth Avenue, New York, NY 10003, USA



(ii)

NOW AVAILABLE

Second Edition

The Earth's Tectonosphere

Its Past Development and Present Behavior

J. H. Tatsch

We are pleased to announce that the first (1972) edition of *The Earth's Tectonosphere* has been completely revised. The new edition updates the results of our continuing research to determine the most probable geometrical, mechanical, thermal, and chemical aspects of the origin, evolution, and present behavior of the Earth's upper 1000 kilometers. Included are about 80 of John C. Holden's inimitable drawings.

More specifically, this book is a multiple-hypothesis analysis of the development of the Earth's internal structure during the past 4.6 billion years, of how this deep structure has controlled the Earth's internal behavior since the Earth began, and of why the surficial geophenomena and features are manifestations of that internal behavior.

Chapter headings: 1, The origin of the solar system; 2, The Earth-Moon system; 3, The Tectonospheric Earth Model; 4, The Earth as a planet; 5, The crust of the Earth; 6, The tectonosphere; 7, The orogenic-cratonic structure of the continents; 8, The Earth's deep seismicity; 9, Global patterns of geothermal activity; 10, Intrusive and extrusive activity; 11, Morphology of the Earth; 12, Mountain building; 13, The Earth's gravity field; 14, Geomagnetism and polarity reversals; 15, Continents and oceans; 16, Sea-floor spreading; 17, Continental drift and polar wandering; 18, Plate tectonics and related omniductive processes; 19, Asteroids, meteorites, and tektites; 20, The integrated Earth and its future.

The Tectonospheric Earth Model concept, developed in the first edition and repeated in this edition, differs essentially from other global-tectonics concepts in two salient respects: (1) it embodies the geometrical, mechanical, thermal, and chemical aspects of a driving mechanism that has existed during the entire 4.6 billion years that the Earth is believed to have been in existence; and (2) it encompasses the Earth's spatio-temporal framework to a depth of 1000 km during these 4.6 billion years.

The second edition attempts to show, as did the first, how these two differences permit a more meaningful interpretation of the origin, evolution, and present characteristics of the Earth's behavior than is possible through other global-tectonics concepts. This pertains not only to the Earth's lithospheric plates but to all plates, blocks, and other forms of material that have evolved within the upper 1000 km of the Earth during the past 4.6 billion years.

The Tectonospheric Earth Model has been used as the basis for 10 correlative follow-on books: *Mineral Deposits* (1973), *The Moon* (1974), *Petroleum Deposits* (1974), *Copper Deposits* (1975), *Gold Deposits* (1975), *Uranium Deposits* (1976), *Geothermal Deposits* (1976), *Earthquakes* (1977), *Coal Deposits* (in press), and *Iron Deposits* (in preparation).

Available directly from the publisher or through book dealers in all parts of the world. Hard cover, 6 × 9 inches, 468 pages. Table of contents, line drawings, maps, bibliography, index. \$30. LC:74-78917. ISBN: 0-912890-03-7. 1977.

Tatsch Associates

120 Thunder Road Sudbury, Massachusetts 01776 U.S.A.

(iii)

Geological Magazine

with which is incorporated

The Geologist

founded in 1864 by the late DR HENRY WOODWARD, F.R.S.

Edited by W. B. HARLAND, M.A. C. P. HUGHES, M.A. and G. A. CHINNER, PH.D.

assisted by MRS M. J. MASON

Associate editors

SIR KINGSLEY DUNHAM, D.SC., F.R.S. MR N. L. FALCON, M.A., F.R.S. PROFESSOR LEONARD HAWKES, D.SC., F.R.S. SIR PETER KENT, D.SC., F.R.S. DR S. R. NOCKOLDS, PH.D., F.R.S. PROFESSOR F. W. SHOTTON, M.B.E., M.A., SC.D., F.R.S. SIR JAMES STUBBLEFIELD, D.SC., F.R.S.

Volume 114 of Whole Series January–December 1977

CAMBRIDGE UNIVERSITY PRESS CAMBRIDGE · LONDON · NEW YORK

PUBLISHED BY

THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS

The Pitt Building, Trumpington Street, Cambridge CB2 1RP Bentley House, P.O. Box 92, 200 Euston Road, London NW1 2DB 32 East 57th Street, New York, N.Y. 10022

© Cambridge University Press 1977

Pagination and dates of publication of issues in this volume

Number 1: pp. 1-80	January 1977
2: pp. 81-164	March 1977
3: pp. 165-248	May 1977
4: pp. 249-328	
5: pp. 329-408	September 1977
	November 1977

.

Printed in Great Britain at the University Press, Cambridge

Contents

ARTICLES

(Figures in **bold** type denote number of issue)

AMIRI-GARROUSSI, K. Origin of montmorillonite in early Jurassic shales of NW Scotland, 4, 281 AWASTHI, A. K. & KUMAR, S. A nonogram to estimate the size for a random sample from a normal population for mean, 6, 475 BANNER, F. T. Planktonic biostratigraphic correlation, Californian Early Palaeogene, 6, 485 BUSSELL, M. A. & McCOURT, W. J. The Iglesia Irca intrusion and the role of gas brecciation in the emplacement of the Coastal Batholith of Peru, 5, 375 COOK. A. F. Temporary exposure of the Middle Cambrian, Warwickshire, England, 1, 33 CRAWFORD, A. R. Danubian deviations and mantle diapirism: a possible origin of the Carpathian Arc, 2, 115 DAGGER, G. W. Controls of copper mineralization at Coniston, English Lake District, 3, 195 DEELMAN, J. C. Surface roughness measurements and the analysis of petrofabrics, 6, 459 FAIRCHILD, I. J. Phengite spherules from the Dalradian Bonahaven Formation, Islay, Scotland: glauconitized microfossils? 5, 355 FINLOW-BATES, T. The formation of fibrous texture in some veins, 2, 141 FORTEY, R. A. & MORRIS, S. F. Variation in lens packing of Phacops (Trilobita), 1, 25 GOODE, A. D. T. Intercumulus igneous layering in the Kalka Layered Intrusion, central Australia, 3, 215 GOODE, A. D. T. Vertical igneous layering in the Ewarara layered intrusion, central Australia, 5, 365 HARLAND, W. B. International Stratigraphic Guide, 1976, 3, 229 HARRISON, R. K., SNELLING, N. J., MERRIMAN, R. J., MORGAN, G. E. & GOODE, A. J. J. The Wolf Rock, Cornwall: new chemical, isotopic age and palaeomagnetic data, 4, 249 HEY, R. W. & BRENCHLEY, P. J. Volcanic pebbles from Pleistocene gravels in Norfolk and Essex, 3, 219 HURFORD, A. J. Fission track dates from two Galloway granites, Scotland, 4, 299

JENKYNS, H. C. & SENIOR, J. R.

A Liassic palaeofault from Dorset, England, 1, 47

KWAK, T. A. P.

Scapolite compositional change in a metamorphic gradient and its bearing on the identification of meta-evaporite sequences, 5, 343

LANPHERE, M. A., CHURKIN, Jr M. & EBERLEIN, G. D.

Radiometric age of the *Monograptus cyphus* graptolite zone in Southeastern Alaska – an estimate of the age of the Ordovician-Silurian boundary, 1, 15

MOESKOPS, P. G.

Volume increase serpentinisation in Archaean quench texture ultramafic rocks near Kalgoorlie, Western Australia, 1, 41

MUIR, M. D.

Late Precambrian Microfossils, 5, 395

MULLAN, H. S. & BUSSELL, M. A.

The basic rock series in batholitic associations, 4, 265

ODELL, J.

Description in the geological sciences and the Lithostratigraphic Descriptive System, LSDØ2, 2, 81

PRESTON, J.

An unusual occurrence of quartz and amorphous silica at Carmean, Moneymore, Co. Antrim, 5, 389

RHODES, S. & GAYER, R. A.

Non-cylindrical folds, linear structures in the X direction and mylonite developed during translation of the Caledonian Kalak Nappe Complex of Finnmark, 5, 329

ROGERS, N. W. & GIBSON, I. L.

The petrology and geochemistry of the Creag Dubh composite sill, Whiting Bay, Arran, Scotland, 1, 1

SCRUTTON, C. T.

Facies variations in the Devonian limestone of eastern South Devon, 3, 165

SHANNON, P. M.

Diagenetic concretions from the Ribband Group sediments of County Wexford, Ireland, 2, 127

SHAW, F. C. & FORTEY, R. A.

Middle Ordovician facies and trilobite faunas in N. America, 6, 409

SHIRAV (SCHWARTZ), M.

The occurrence of large scale kink bands in Campanian chalk at the Gulf of Elat ('Aqaba) rift zone, 6, 467

SINHA ROY, S.

Mylonitic microstructures and their bearing on the development of mylonites – an example from deformed trondhjemites of the Bergen Arc region, SW Norway, 6, 445

SMITH, D. G.

Late Triassic palynology and the definition of the lower boundary of the Rhaetian Standard Age/Stage, 2, 153

STAUFFER, P. H. & SNELLING, N. J.

A Precambrian trondhjemite boulder in Palaeozoic mudstones of NW Malaya, 6, 479

Contents

STOREY, B. C., MAIR, B. F. & BELL, C. M.

The occurrence of Mesozoic oceanic floor and ancient continental crust on South Georgia, 3, 203

STRIMPLE, H. L.

Unusual morphological features in the blastoid genus Pentremites, 1, 9

STRIMPLE, H. L.

The inadunate crinoid genus Cryphiocrinus Kirk, 3, 209

VISWANATHAN, S.

Differentiated dyke rocks of Mer Mundwara, Rajasthan, and their metallogenic significance, 4, 291

WEBBY, B. D.

Labechia aldonensis sp. nov.; an Ordovician stromatoporoid from Scotland, 1, 53

WILLIAMS, P. J.

Properties of frozen ground: Russian approaches, 1, 65

WRIGHT, J. V. & COWARD, M. P.

Rootless vents in welded ash-flow tuffs from northern Snowdonia, North Wales, indicating deposition in a shallow water environment, 2, 133

CORRESPONDENCE

ALI, O. E. Jurassic hazards to coral growth, 1, 63

BATHURST, R. G. C. Ordovician Meiklejohn bioherm, Nevada, 4, 308

BREMNER, D. & LEAKE, B. E. On the western boundary of the Galway Granite, 3, 227

COWIE, J. W. Upper Precambrian (Riphean) in the Southern Urals of U.S.S.R., 4, 305

FIRMAN, R. J. & DAGGER, G. W. Lake District copper, 6, 483

MARSH, J. S. & ROCK, N. M. S. The role of CO₂ in alkali rock genesis, 2, 149

NOCKOLDS, S. R. & Le BAS, M. J. Average calc-alkali basalt, 4, 311

SINHA ROY, S. & FERGUSON, C. C. Textural patterns at porphyroblast margins, 2, 147

STANTON, W. I. & SCHERMERHORN, L. J. G. and WILLIAMS, G. E. Late Precambrian glacial climate and the Earth's obliquity – a discussion, 1, 57

SOZANSKY, V. I. & WILSON, H. E. Note on the stratigraphic position of igneous rocks of the Larne Borehole, County Antrim, 2, 145

VIDAL, G.

Late Precambrian Microfossils, 5, 393

REVIEWS

Les ammonitines de Carixien de la Montagne du Bakony, 3, 239

- Annotated Bibliographies of Mineral Deposits in Africa, Asia (exclusive of U.S.S.R.) and Australasia, 5, 399
- Aplanissements cuirassés et enrichissement des gisements de manganese dans quelques regions d'Afrique de l'ouest, 3, 244

An appraisal of physiographic units for predicting site conditions in arid areas, 2, 157

An atlas of microfacies in Carboniferous Carbonates of the Canadian Cordillera, 4, 318

- The Boreal Lower Cretaceous, 1, 69
- Bretagne. Guides Géologiques Régionaux, 5, 405
- The British Journal for the History of Science. Lyell Centenary Issue, 4, 315
- Carbonaceous Meteorites, 1, 71
- Chemical Methods of Rock Analysis, 6, 489
- Children of the Universe, 1, 74
- Compaction of Coarse-grained Sediments, 5, 401
- Conodont Paleoecology, 5, 404
- Conodonts of the Waterways Formation (Upper Devonian) of northeastern and central Alberta, 2, 160
- The Cretaceous System in the Western Interior of North America, 6, 489
- Crustal Movement, 3, 240
- Depth distribution of benthic foraminifera on the continental slope of Portugal, 4, 320
- A Dictionary of Earth Sciences, 4, 320
- Drifting Continents, 2, 159
- Earth Resources. A dictionary of terms and concepts, 3, 245
- Ecology and Earth History, 4, 319
- The Environment. A dictionary of the world around us, 3, 245
- Environmental Geology, 3, 241
- ERTS-1. A new window on our planet, 3, 245
- Europe from Crust to Core, 5, 402
- The evolutionary significance of the exine, 2, 158
- Exploration of the Continental shelf of the Barents Sea from the time of Fridtjof Nansen until today, 6, 491
- Explosion Seismology in Central Europe, 4, 321
- Feldspar Minerals, 1, 69
- Field Geology in Colour, 4, 317
- Foraminifera, 5, 403
- Fundamentals of Palaeontology, 4, 317
- Fundamentals of Rock Mechanics, 3, 240
- The Geological Evolution of the British Isles, 4, 318
- Geological Factor Analysis, 3, 237
- Geological Maps and their Interpretation, 4, 321
- Geology and Palaeontology of Southeast Asia, 3, 236
- Geology for Schools, 3, 246
- The Geology of Lincolnshire, 5, 402
- Geology of Turkey, 5, 399
- Geography of Svalbard. A short survey, 6, 491
- Global Geology, 6, 489
- Gondwana geology, 1, 75
- The gravity and magnetic fields of Atlantic offshire Canada, 1, 75
- History of the Earth Sciences during the Scientific and Industrial Revolutions with special emphasis on the Physical Geosciences, 4, 315
- An Introduction to Geological Maps, 4, 321
- JLC and Advanced FORTRAN Programming, 3, 243
- Jurassic Environments, 3, 241
- Jurassic Paleobiogeography of Alaska, 3, 242
- Late Quaternary stratigraphy based on planktonic foraminifera off Senegal, 4, 320
- Leitfossilien. No. 1. Die Trilobiten des Ober-Devon, Karbon und Perm, 4, 322

Contents

Mesozoic and ?Tertiary rocks of Quatsino Sound, Vancouver Island, British Columbia, 4, 318 Metallogenv and Plate Tectonics. 6, 490 Microfacies and Microfossils of the Miocene Reef Carbonates of the Philippines, 6, 493 Middle Jurassic (Bajocian) Ammonites from eastern Oregon, 4, 323 Middle Jurassic (Bajocian and Bathonian) ammonites from northern Alaska, 3, 242 Morphology and Biology of Reptiles, 5, 399 Noncystimorph colonial rugose corals of the Onesquethaw and lower Cazenovia Stages (Lower and Middle Devonian) in New York and adjacent areas, 3, 244 North Sea and European Shelf Oil and Gas Activity Map, 6, 493 Paleotectonic investigations of the Pennsylvanian System in the United States, 3, 237 The Periglacial Environment, 4, 313 Planet Earth in Colour, 4, 317 Proterozoic and Paleozoic Geology of Banks Island, Arctic Canada, 4, 319 Pyrénées Occidentales. Béarn, Pays Basque, 3, 247 Quantitative Techniques for the Analysis of Sediments, 3, 243 Recent Foraminifera, 2, 158 The Science of Speleology, 3, 238 Slate. Mineral Resources Consultative Committee, 3, 236 Soils of Wisconsin, 6, 492 Soil Taxonomy. A Basic System of Soil Classification for making and interpreting Soil Surveys, 6.492 Spilites and Spilitic Rocks, 1, 73 Stratigraphic distribution and zonation of Jurassic (Callovian) ammonites in southern Alaska, 3, 242 The Study of Trace Fossils, 2, 157 Theory and problems of Earth Sciences, 2, 160 Upper Jurassic - Lower Cretaceous dinoflagellate assemblages from Arctic Canada, 2, 159 Val. de Loire. Anjou, Touraine, Orléanais, Berry, 3, 247 Vosges Alsace, 3, 247 World Mineral Supplies, 4, 314

Publications Received

Lists appear beginning pages 1, 77; 2, 161; 3, 248; 4, 324; 5, 407; 6, 494

to Authors, key words in titles and to new taxa in Volume 114; (R) indicates Review

- Africa, Mineral Deposits (R), 399 Afrique, manganese (R), 244 Alaska, Jurassic (R), 242; Ordovician - Silurian boundary, 15 Alberta (R), 160 Ali, O. E. Jurassic hazards to coral growth, 63 Alkali rock genesis, 149 Amiri-Garroussi, K. Origin of montmorillonite in the early Jurassic shales of N.W. Scotland, 281 Ammonites, Jurassic, Alaska (R), 242; Oregon (R), 323 Ammonitines, Montagne du Bakony (R), 239 Anjou (R), 247 Antrim, Larne Borehole, 145; guartz and silica, 389 Archaean, 41 Arid areas (R), 157 Arran, Creag Dubh composite sill, 1 Ash - flow tuffs, welded, 133 Asia, Mineral Deposits (R), 399 Australasia, Mineral Deposits (R), 399 Australia, central, 215; igneous layering, 365 Awasthi, A. K. & Kumar, S. A nomogram to estimate the size for a random sample from a normal population for mean, 475 Banks Island, Canada (R), 319 Banner, F. T. Planktonic biostratigraphic correlation, Californian Early Palaeogene, 485 Barents Sea, continental shelf (R), 491 Le Bas, M. J. & Nockolds, S. R. Average calc-alkali basalt, 311 Basalt, 311 Batholith, Peru, 375 Batholithic, 265 Bathurst, R. G. C. Ordovician Meiklejohn bioherm, Nevada, 308 Béarn (R), 247 Bell, C. M., Storey, B. C. & Mair, B. F. The occurrence of Mesozoic oceanic floor and ancient continental crust on South Georgia, 203 Bergen Arc region, SW Norway, 445 Berry (R), 247 Bioherm, Meiklejohn, 308 Blastoid, 9 Bonahaven Formation, 355 Boreal, Cretaceous (R), 69 Bremner, D. & Leake, B. E. On the western boundary of the Galway Granite, 227 Brenchley, P. J. & Hey, R. W. Volcanic pebbles from Pleistocene gravels in Norfolk and Essex, 219 Bretagne (R), 405 British Isles, Geological Evolution (R), 318
- Bussell, M. A. & M^cCourt, W. J. The Iglesia Irca intrusion and the role of gas brecciation in the emplacement of the Coastal Batholith of Peru, 375

Х

- Bussell, M. A. & Mullan, H. S. The basic rock series in batholithic associations, 265
- Calc alkali basalt, 311
- Caledonian Kalak Nappe Complex, 329
- Cambrian, England, 33
- Canada, gravity and magnetic fields (R), 75; Jurassic Cretaceous dinoflagellate assemblages (R), 159; Proterozoic and Paleozoic, Banks Island (R), 319
- Canadian Cordillera (R), 318
- Carboniferous Carbonates (R), 318
- Carixien, ammonitines (R), 239
- Carpathian Arc, 115
- Central Europe, explosion seismology (R), 321
- Cephalopoda (R), 317
- Chalk, Campanian, 467
- Chemical Methods of Rock Analysis (R), 489
- Churkin, Jr M., Lanphere, M. A. & Eberlein, G. D. Radiometric age of the *Monograptus cyphus* graptolite zone in Southeastern Alaska An estimate of the age of the Ordovician–Silurian boundary, 15
- Classification, soil (R), 492
- CO₂, 149
- Compaction of coarse-grained sediments (R), 401
- Conodont Paleoecology (R), 404
- Conodonts (R), 160
- Continental crust, 203
- Continental shelf, Barents Sea (R), 491
- Continental slope, Portugal (R), 320
- Cook, A. F. Temporary exposure of the Middle Cambrian, Warwickshire, England, 33
- Copper, 483; mineralization, 195
- Coral growth, 63
- Corals, Devonian (R), 244
- Cornwall, Wolf Rock, 249
- Correlation, 485
- Coward, M. P. & Wright, J. V. Rootless vents in welded ash-flow tuffs from northern Snowdonia, North Wales, indicating deposition in a shallow water environment, 133
- Cowie, J. W. Upper Precambrian (Riphean) in the Southern Urals of U.S.S.R., 305
- Crawford, A. R. Danubian deviations and mantle diapirism: a possible origin of the Carpathian Arc, 115
- Creag Dubh composite sill, 1
- Cretaceous, Boreal (R), 69; dinoflagellate assemblages, Canada (R), 159; System, North America (R), 489
- Crustal Movement (R), 240
- Crust to Core, Europe (R), 402
- Cryphiocrinus, 209
- Dagger, G. W. Controls of copper mineralization at Coniston, English Lake District, 195
- Dagger, G. W. Lake District copper, 483
- Dalradian, 355
- Danubian deviations, 115
- Deelman, J. C. Surface roughness measurements and the analysis of petrofabrics, 459 Devon, eastern south, 165
- Devonian, Conodonts (R), 160; Corals (R), 244; limestones, 165

Diagenetic concretions, 127 Dinoflagellate assemblages (R), 159 Dorset, palaeofault, 47 Drifting Continents (R), 159 Dyke rocks, Mer Mundwara, 291 Earth (R), 317; History (R), 319; Resources (R), 245 Earth Sciences, Dictionary (R), 320; History of (R), 315; Theory and problems (R), 160 Earth's obliquity, 57 Eberlein, G. D., Lanphere, M. A. & Churkin, Jr M. Radiometric age of the Monograptus cyphus graptolite zone in Southeastern Alaska - an estimate of the age of the Ordovician - Silurian boundary, 15 Ecology (R), 319 Environment (R), 245 Environmental Geology (R), 241 Environments, Jurassic (R), 241 ERTS (R), 245 Essex, 219 Europe, Crust to Core (R), 402 European Shelf (R), 493 Ewarara layered intrusion, Australia, 365 Exine, evolutionary significance (R), 158 Factor Analysis (R), 237 Fairchild, I. J. Phengite spherules from the Dalradian Bonahaven Formation, Islay, Scotland: glauconitized microfossils? 355 Feldspar Minerals (R), 69 Ferguson, C. C. & Harte, B. Textural patterns at porphyroblast margins, 148 Field Geology (R), 317 Finlow-Bates, T. The formation of fibrous texture in some veins, 141 Finnmark, 329 Firman, R. J. Lake District Copper, 483 Fission track dates, 299 Folds, non-cylindrical, 329 Foraminifera (R), 403; Portugal (R), 320; Recent (R), 158; Senegal (R), 320 Fortey, R. A. & Morris, S. F. Variation in lens packing of *Phacops* (Trilobita), 25 Fortey, R. A. & Shaw, F. C. Middle Ordovician facies and trilobite faunas in N. America, 409 Fortran Programming (R), 243 Frozen ground, 65 Galway Granite, 227 Gas brecciation, 375 Gayer, R. A. & Rhodes, S. Non-cylindrical folds, linear structures in the X direction and mylonite developed during translation of the Caledonian Kalak Nappe Complex of Finnmark, 329 Geochemistry, 1 Geological, Evolution, British Isles (R), 318; Factor Analysis (R), 237; Maps (R), 321; Sciences, 81

xi

Geology, Lincolnshire (R), 402; Schools (R), 246; Southeast Asia (R), 236; Turkey (R), 399

Gibson, I. L. & Rogers, N. W. The petrology and geochemistry of the Creag Dubh composite sill, Whiting Bay, Arran, Scotland, 1

Glacial, 57

xii

- Glauconitized microfossils, 355
- Global Geology (R), 489
- Gondwana (R), 75
- Goode, A. D. T. Intercumulus igneous layering in the Kalka Layered Intrusion, central Australia, 215
- Goode, A. D. T. Vertical igneous layering in the Ewarara layered intrusion, central Australia, 365
- Goode, A. J. J., Harrison, R. K., Snelling, N. J., Merriman, R. J. & Morgan, G. E. The Wolf Rock, Cornwall: new chemical, isotopic age and palaeomagnetic data, 249
- Granites, Galloway, 299; Galway, 227
- Gravity, Canada (R), 75
- Harland, W. B. International Stratigraphic Guide 1976, 229
- Harrison, R. K., Snelling, N. J., Merriman, R. J., Morgan, G. E. & Goode, A. J. J. The Wolf Rock, Cornwall: new chemical isotopic age and palaeomagnetic data, 249
- Hey, R. W. & Brenchley, P. J. Volcanic pebbles from Pleistocene gravels in Norfolk and Essex, 219
- Hurford, A. J. Fission track dates from two Galloway granites, Scotland, 299
- Iglesia Irca intrusion, Peru, 375
- Igneous layering, Australia, 215; 365
- Igneous rocks, County Antrim, 145
- Ireland, 127
- Islay, Scotland, 355
- Isotopic age, 249
- Jenkyns, H. C. & Senior, J. R. A Liassic palaeofault from Dorset, 47
- Jurassic, Ammonites (R), 323; Coral growth, 63; dinoflagellate assemblages (R), 159; Environments (R), 241; NW Scotland, 281; Paleobiogeography (R), 242
- Kalka Intrusion, 215
- Karbon, Trilobiten (R), 322
- Kumar, S. & Awasthi, A. K. A nomogram to estimate the size for a random sample from a normal population for mean, 475
- Kwak, T. A. P. Scapolite compositional change in a metamorphic gradient and its bearing on the identification of meta-evaporate sequences, 343
- Labechia aldonensis sp. nov, 53
- Lake District, 195; 483
- Lanphere, M. A., Churkin, Jr M. & Eberlein, G. D. Radiometric age of the *Monograptus cyphus* graptolite zone in Southeastern Alaska an estimate of the age of the Ordovician-Silurian boundary, 15
- Leake, B. E. & Bremner, D. On the western boundary of the Galway Granite, 227
- Lens packing of *Phacops*, 25
- Liassic, Dorset, 47
- Limestones, Devonian, 165
- Lincolnshire (R), 402
- Linear structures, 329
- Lithostratigraphic Descriptive System, 81
- LSDØ2, 81
- Lyell Centenary (R), 315
- Magnetic fields (R), 75
- Mair, B. F., Storey, B. C. & Bell, C. M. The occurrence of Mesozoic oceanic floor and ancient continental crust on South Georgia, 203

Malaya, 479

Manganese (R), 244

- Mantle diapirism, 115
- Marsh, J. S. The role of CO₂ in alkali rock genesis, 149
- M^cCourt, W. J. & Bussell, M. A. The Iglesia Irca intrusion and the role of gas brecciation in the emplacement of the coastal Batholith of Peru, 375
- Merriman, R. J., Harrison, R. K., Snelling, N. J., Morgan, G. E. & Goode, A. J. J. The Wolf Rock, Cornwall: new chemical, isotopic age and palaeomagnetic data, 249
- Mesozoic, South Georgia, 203; Vancouver Island (R), 318
- Meta-evaporite sequences, 343
- Metallogeny and Plate Tectonics (R), 490
- Metamorphic gradient, 343.
- Meteorites, Carbonaceous (R), 71
- Microfossils, Precambrian, 393; 395
- Mineral Deposits in Africa, Asia and Australasia (R), 399
- Mineral Supplies (R), 314
- Miocene Reef Carbonates (R), 493
- Moeskops, P. G. Volume increase serpentinization in Archaean quench texture ultramafic rocks near Kalgoorlie, Western Australia, 41
- Mollusca (R), 317
- Monograptus cyphus Zone, 15
- Montagne du Bakony (R), 239
- Montmorillonite, 281
- Morgan, G. E., Harrison, R. K., Snelling, N. J., Merriman, R. J. & Goode, A. J. J. The Wolf Rock, Cornwall: new chemical, isotopic age and palaeomagnetic data, 249
- Morris, S. F. & Fortey, R. A. Variation in lens packing of Phacops (Trilobita), 25
- Muir, M. D. Late Precambrian Microfossils, 395
- Mullan, H. S. & Bussell, M. A. The basic rock series in batholithic associations, 265
- Mylonite, 329
- Mylonites, SW Norway, 445
- Nevada, 308
- New York (R), 244
- Nockolds, S. R. & Le Bas, M. J. Average calc-alkali basalt, 311
- Nomogram, 475
- Norfolk, 219
- North America, Cretaceous (R), 489; Ordovician, 409
- North Sea (R), 493
- NW Scotland, 281
- Ober-Devon, Trilobiten (R), 322
- Odell, J. Description in the geological sciences and the Lithostratigraphic Descriptive System, LSDØ2, 81
- Oil and Gas (R), 493
- Ordovician, N. America, 409; Nevada, 308; Silurian boundary, 15; Stromatoporoid, 53
- Oregon (R), 323
- Orléanais (R), 247
- Palaeofault, Dorset, 47
- Palaeogene, 485
- Palaeomagnetic data, 249
- Palaeontology, Fundamentals (R), 317; Southeast Asia (R), 236

xiv

Paleobiogeography, Jurassic (R), 242 Paleoecology, Conodont (R), 404 Paleotectonic, Pennsylvanian (R), 237 Paleozoic (R), 319 Palynology, 153 Pays Basque (R), 247 Pennsylvanian (R), 237 Pentremites, 9 Periglacial Environment (R), 313 Perm, Trilobiten (R), 322 Peru, 375 Petrofabrics, 459 Petrology, Creag Dubh composite sill, 1 Phacops (Trilobita), lens packing, 25 Phengite spherules, 355 Philippines (R), 493 Plate Tectonics (R), 159; Metallogeny (R), 490 Pleistocene, 219 Population, 475 Porphyroblast margins, 147 Portugal, continental slope, benthic foraminifera (R), 320 Precambrian, glacial, 57; Malaya, 479; Microfossils, 393; 395; Southern Urals, 305 Preston, J. An unusual occurrence of Quartz and amorphous silica at Carmean, Moneymore, Co. Antrim, 389 Proterozoic (R), 319 Pyrénées Occidentales (R), 247 Quantitative techniques (R), 243 Quartz, Co. Antrim, 389 Quaternary (R), 320 Radiometric age, 15 Rajasthan, 291 Reptiles (R), 399 Rhaetian, 153 Rhodes, S. & Gayer, R. A. Non-cylindrical folds, linear structures in the X direction and mylonite developed during translation of the Caledonian Kalak Nappe Complex of Finnmark, 329 **Ribband Group**, 127 Rift zone, Gulf of Elat ('Aqaba), 467 Rock analysis, Chemical Methods (R), 489 Rock Mechanics (R), 240 Rock, N. M. S. The role of CO₂ in alkali rock genesis, 150 Rogers, N. W. & Gibson, I. L. The petrology and geochemistry of the Creag Dubh composite sill, Whiting Bay, Arran, Scotland, 1 Sample, 475 Scapolite, 343 Schermerhorn, L. J. G. & Stanton, W. I. Late Precambrian glacial climate and the Earth's obliquity - a discussion, 57 Schools, Geology for (R), 246 Scotland, Creag Dubh composite sill, 1; Dalradian, 355; granites, 299; Ordovician stromatoporoid, 53

- Scrutton, C. T. Facies variations in the Devonian limestones of eastern South Devon, 165
- Sediments, Analysis (R), 243; Coarse-grained (R), 401
- Seismology (R), 321
- Senegal, Quaternary, planktonic foraminifera (R), 320
- Senior, J. R. & Jenkyns, H. C. A Liassic palaeofault from Dorset, 47
- Serpentinization, 41
- Shallow water environment, 133
- Shannon, P. M. Diagenetic concretions from the Ribband Group sediments of County Wexford, Ireland, 127
- Shaw, F. C. & Fortey, R. A. Middle Ordovician facies and trilobite faunas in N. America, 409
- Shirav (Schwartz), M. The occurrence of large scale kink bands in Campanian Chalk at the Gulf of Elat ('Aqaba) rift zone, 467
- Silica, 389
- Sinha Roy, S. Mylonitic microstructures and their bearing on the development of mylonites an example from deformed trondhjemites of the Bergen Arc region, SW Norway, 445
- Sinha Roy, S. Textural patterns at porphyroblast margins, 147
- Site conditions (R), 157
- Slate (R), 236
- Smith, D. G. Late Triassic palynology and the definition of the lower boundary of the Rhaetian Standard Age/Stage, 153
- Snelling, N. J., Harrison, R. K., Merriman, R. J., Morgan, G. E. & Goode, A. J. J. The Wolf Rock, Cornwall: new chemical, isotopic age and palaeomagnetic data, 249
- Snelling, N. J. & Stauffer, P. H. A Precambrian trondhjemite boulder in Palaeozoic mudstones of NW Malaya, 479
- Snowdonia, 133
- Soil Taxonomy (R), 492
- Southeast Asia (R), 236
- South Georgia, 203
- Sozansky, V. I. Note on the stratigraphic position of igneous rocks of the Larne Borehole, County Antrim, 145
- Speleology (R), 238
- Spilites (R), 73
- Stanton, W. I. & Schermerhorn, L. J. G. Late Precambrian glacial climate and the Earth's obliquity – a discussion, 57
- Stauffer, P. H. & Snelling, N. J. A Precambrian trondhjemite boulder in Palaeozoic mudstones of NW Malaya, 479
- Storey, B. C., Mair, B. F. & Bell, C. M. The occurrence of Mesozoic oceanic floor and ancient continental crust on South Georgia, 203
- Stratigraphic Guide, 229
- Strimple, H. L. The inadunate crinoid genus Cryphiocrinus Kirk, 209
- Strimple, H. L. Unusual morphological features in the blastoid genus Pentremites, 9
- Stromatoporoid, Scotland, 53
- Surveys, soil (R), 492
- Taxonomy, soil (R), 492
- Tertiary, Vancouver Island (R), 318
- Touraine (R), 247
- Trace Fossils (R), 157
- Triassic, 153
- Trilobita, Phacops, 25

Trilobite faunas, N. America, 409 Trilobiten, Karbon (R), 322; Ober-Devon (R), 322; Perm (R), 322 Trondhjemite, 479 Trondhiemites. Bergen Arc region, 445 Turkey (R), 399 Ultramafic rocks, 41 United States (R), 237 Universe, Children (R), 74 U.S.S.R. Precambrian, 305 Val de Loire (R), 247 Vancouver Island (R), 318 Veins, 141 Vents, 133 Vidal, G. Late Precambrian microfossils, 393 Viswanathan, S. Differentiated dyke rocks of Mer Mundwara, Rajasthan and their metallogenic significance, 291 Volcanic pebbles, 219 Vosges Alsace (R), 247 Webby, B. D. Labechia aldonensis sp. nov.; an Ordovician stromatoporoid from Scotland, 53 Western Australia, 41 Williams, G. E. Late Precambrian glacial climate and the Earth's obliquity - a discussion, 61 Williams, P. J. Properties of frozen ground: Russian approaches, 65 Wilson, H. E. Note on the stratigraphic position of igneous rocks of the Larne Borehole, County Antrim, 146

Wright, J. V. & Coward, M. P. Rootless vents in welded ash-flow tuffs from northern Snowdonia, North Wales, indicating deposition in a shallow water environment, 133

NOTES FOR CONTRIBUTORS

Contributions for publication should be addressed to The Editors, *Geological Magazine*, Sedgwick Museum, Downing Street, Cambridge CB2 3EQ, England.

All contributions, whether articles, correspondence or reviews, must be typed in duplicate on one side of the paper, double spaced throughout, with a wide margin on the left of each page and a narrower margin on the right. Any minor corrections should be made neatly in the typescript, leaving the margins clear.

The total length of a paper should not in general exceed 20 pages of the *Geological Magazine*; preference and priority are given to short papers. Longer papers (between 20 and 40 pages of *Geological Magazine*) will from time to time be considered, but authors wishing to submit such manuscripts should first request further details.

The accuracy of references is the responsibility of authors. References must be double spaced and abbreviated in the form of the World List of Scientific Periodicals 4th Edition as far as possible, e.g. Lapworth, C. 1878. The Moffat Series. Q. *Jl geol.* Soc., Lond. **34**, 240–343. Books should be cited briefly as: Burns, R. G. 1970. Mineralogical applications of crystal field theory. 224 pp., C.U.P., London. Unpublished work, e.g. from theses, should normally be referred to in the text in parentheses and not included in the reference list unless in the press.

Articles must be accompanied by a brief summary. Contributions should follow the general style of papers in recent issues of the Magazine and the principles laid down in *Notes to Authors (Proc. Geol. Soc. Lond.*, No. 1627. Oct. 1965). Headings should be set out clearly, but not underlined. Primary headings should be in lower case, at margin, with arabic numeral; sub-headings should be numbered 2.*a*, 2.*b*, etc., and tertiary headings 2.*a*.1., 2.*a*.2. No cross-references should be given by page number, but 'above' and 'below' should be used with the section specified, e.g. Section 2.*a*.1.

Illustrations must be drawn to allow reduction to maximum size of 200 mm \times 134 mm; originals must not exceed 600 mm \times 402 mm and must be sent in a flat package. Lettering must allow for legibility after reduction (i.e. equivalent to 1 mm as a minimum on reduction). Duplicates of illustrations may be prints or, preferably, reductions. Metric units of the SI system are preferred. Illustrations in the text will be referred to as figures (Fig. 2, 2*a*, etc.), and halftone plates will be referred to (also in arabic) as Plates 2, 2*a*, etc. Folding plates will not be accepted. Captions for figures and plates must be typed on separate sheets.

Twenty-five offprints of each paper will be provided free of charge. Additional offprints may be purchased according to a set scale of charges.

Geological Magazine

Volume 114, Number 6, November 1977

SHAW, F. C. & FORTEY, R. A. Middle Ordovician facies and trilobite faunas in N America	409-443
SINHA ROY, S. Mylonitic microstructures and their bearing on the development of mylonites – an example from deformed trondhjemites of the Bergen Arc region, SW Norway	445-458
DEELMAN, J. C. Surface roughness measurements and the analysis of petrofabrics	459-466
SHIRAV (SCHWARTZ), M. The occurrence of large scale kink bands in Campanian chalk at the Gulf of Elat ('Aqaba) rift zone	467-474
AWASTHI, A. K. & KUMAR, S. A nomogram to estimate the size for a random sample from a normal population mean	475-478
STAUFFER, P. H. & SNELLING, N. J. A Precambrian trondhjemite boulder in Palaeozoic mudstones of NW Malaya	479-482
CORRESPONDENCE Lake District copper: R. J. FIRMAN and G. W. DAGGER	483
NOTICE	484
ESSAY REVIEW	
F. T. BANNER Planktonic biostratigraphic correlation, Californian Early Palaeogene	485-488
REVIEWS	489-493
PUBLICATIONS RECEIVED	494-496

Cambridge University Press 1977

Printed in Great Britain at the University Press, Cambridge