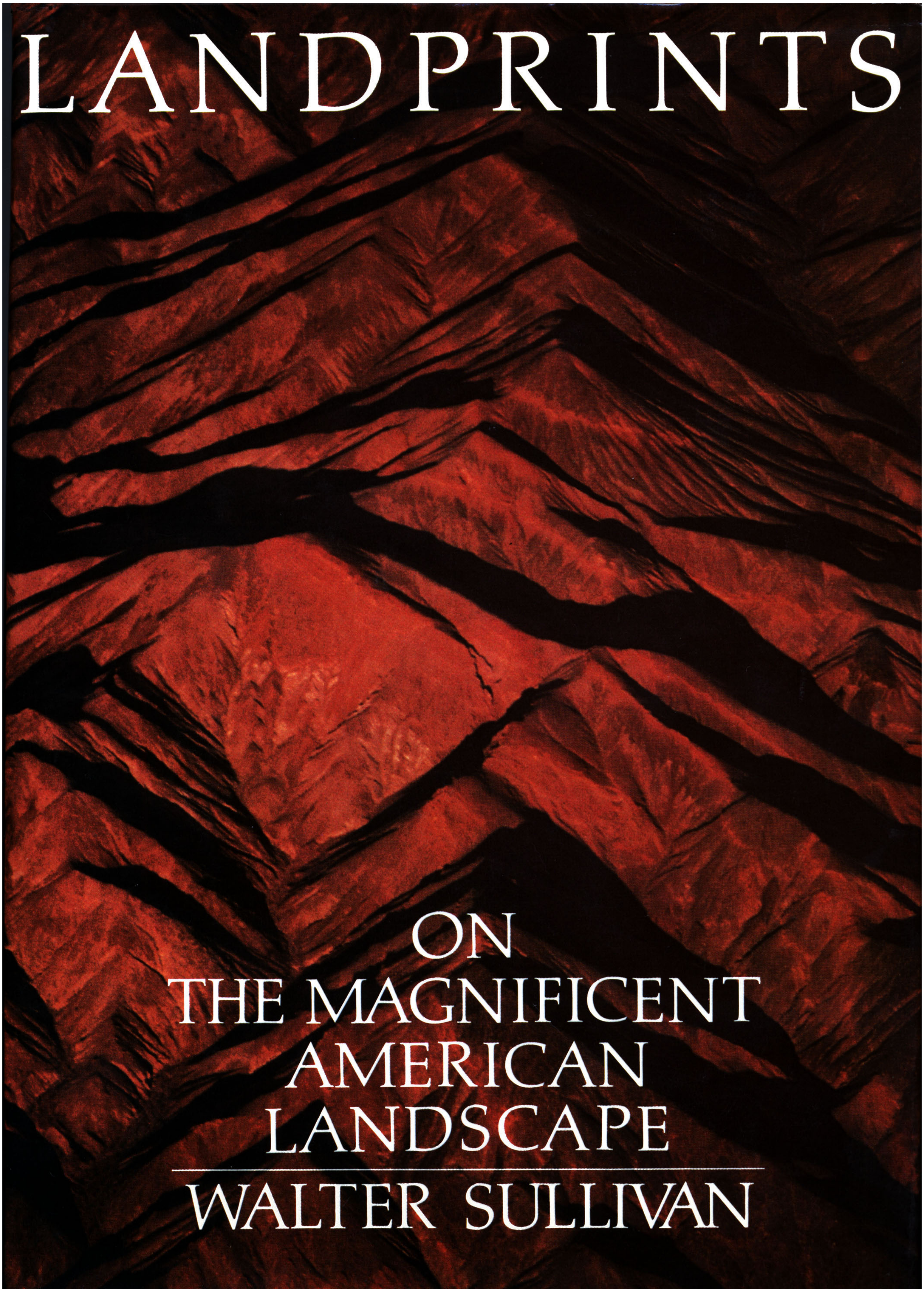
LANDPRINTS



ON THE MAGNIFICENT AMERICAN LANDSCAPE

WALTER SULLIVAN

For Charles Merguerian
With warm regards
and thanks for your help.
Walter P.

Landprints

ACKNOWLEDGMENTS

This book, dealing, as it does, with a very wide range of subjects, could not have been written without the generous help of many specialists. Those who reviewed parts of the manuscript include: Walter Alvarez, University of California, Berkeley; Victor R. Baker, Peter J. Coney, and William R. Dickinson, University of Arizona; Clark Blake, Jr., Robert L. Christiansen, Warren Hamilton, David L. Jones, Kenneth Pierce, and Eugene G. Robertson, U.S. Geological Survey; Norman Berg, American Farmland Trust; Kenneth Bergman, National Weather Service; Eric S. Cheney, University of Washington; Gordon P. Eaton, Texas A&M University; Richard P. Goldthwait, Ohio State University; Leo Hall, University of Massachusetts; John Fraser Hart, University of Minnesota; Robert D. Hatcher, Jr., University of South Carolina; James V. Hines, III, U.S. Army Corps of Engineers; Peter R. Hooper, Washington State University; Nelson Jarmie, Los Alamos National Laboratory; Sheldon Judson and Franklyn B. Van Houten, Princeton University; John B. Lyons, Dartmouth College; Charles Merguerian, Hofstra University; Ralph Moberly, University of Hawaii; James W. H. Monger and Raymond A. Price, Geological Survey of Canada; William D. Pattison, University of Chicago; Orrin H. Pilkey, Duke University; John Rodgers, Yale University; and Eugene Shoemaker, California Institute of Technology and U.S. Geological Survey.

Photographs and other material were provided by many institutions and individuals, including some of those cited above. In addition to those credited beneath their photographs I am particularly indebted to: the Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture in Salt Lake City; that department's Office of Governmental and Public Affairs and its Soil Conservation Service in Washington; Nicholas M. Short and his colleagues at the Goddard Space Flight Center in Maryland; Christopher S. Scotese and his coworkers at the University of Chicago; Jeppesen Sanderson, Inc., in Denver; Canada's National Air Photo Library in Ottawa; and the Space Science and Engineering Center at the University of Wisconsin.

exposed in road cuts and gorges all along the south shore of Lake Ontario. They were subsequently capped by durable dolomite, a stone derived from the shells of countless sea creatures but, unlike its cousin limestone, relatively hard. When, 10,000 years ago, retreat of the last ice sheet allowed the Great Lakes to begin draining down the Saint Lawrence Valley, a great waterfall formed at Niagara. The falls cascade over a rim of dolomite, but they gradually undermine the shale beneath it. This, over the last ten millennia, has created the Niagara Gorge in whose walls the limestone and shale are exposed.

In the 1950's Eugene N. Cameron of the University of Wisconsin delineated an abrupt change in geology along a line that parallels the east side of the highlands in western Connecticut, skirting Torrington on the west. It has now been extended north into Massachusetts along the east flank of the Berkshires and south across Westchester County into New York City along White Plains Road, west of Bronx Park. Although more hidden than the Brevard Zone of the Piedmont, the line (a zone 50 to 300 feet wide) shows ample signs of crushing, compression, and slippage. Along parts of it the movements involved plastic deformation, rather than cracking, that could have occurred only under the heat and pressure at depths of eight miles or more—testimony to the extent of erosion there.

Formations to the west of Cameron's line largely consist of rocks that apparently remained from the continent's earlier coastline as well as greatly altered remnants of the shallow-water material shoved in front of an advancing island arc. Everything to the east of this line is thought to be of exotic, oceanic origin—the leading edge of a slab derived from deep-sea sediments laid down on the outer slope of the continent's original margin. In the process of being shoved inland this material became buried as much as ten miles underground. There it was altered into the rock known locally as Manhattan schist and became plastic enough for folding into extraordinarily complex patterns. One recent autumn day Charles Merguerian of Hofstra University and Leo M. Hall of the University of Massachusetts allowed me to accompany them as they debated the origins of these formations. They focused special attention on a schist exposure west of Riverside Drive at 165th Street in Manhattan. The rock there records a complex history of repeated, widely spaced episodes of intense folding and alteration. Amidst the folds are light-colored veins of coarse crystals intermingled with black tourmalines (not of gem quality) and glittering mica. Much of the ledge is densely studded with garnets. Its subtle north-west-trending grooves testify to far more recent activity—the passing of a great ice sheet. It is hard to believe this material formed as sediment on the surface of a sea floor, was buried eight miles down, and rose again to be exposed after prolonged erosion of what lay above it.

It is on Manhattan schist that most of New York's towering buildings rest. That forming Washington Heights and the other heights in Manhattan is massive, with little evident layering. It towers as a mighty wall alongside the High Bridge sector of Harlem River Drive. Structurally above it, Merguerian has identified another slab of schist, distinctly layered and rich in garnets that he believes underlies much of lower Manhattan. It can be seen at the southeast corner of Central Park and in Riverside Park along the Hudson shore, including the outcrop at 165th Street. Also east of the Hudson River extending from Yonkers into the Bronx and northward beyond White

Filename: 01_Landprints_Apr1984.pdf