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# *Luvin Garcia* IRRIGATION

## IN THE UNITED STATES

BY

### FREDERICK HAYNES NEWELL

HYDRAULIC ENGINEER AND CHIEF OF THE HYDROGRAPHIC BRANCH  
OF THE UNITED STATES GEOLOGICAL SURVEY; CHIEF  
ENGINEER OF THE RECLAMATION SERVICE

*The forest and water problems are perhaps the most vital  
internal questions of the United States.*

ROOSEVELT.

REVISED EDITION

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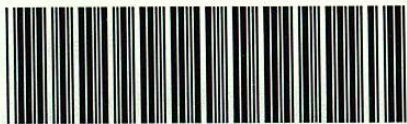


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To

JOHN WESLEY POWELL

THE PIONEER IN SCIENTIFIC CONQUEST OF THE ARID  
LANDS OF THE NATIONAL DOMAIN



There is no one question now before the people of the United States of greater importance than the conservation of the water supply and the reclamation of the arid lands of the West, and their settlement by men who will actually build homes and create communities.

ETHAN ALLEN HITCHCOCK.

Throughout our history the success of the home-maker has been but another name for the upbuilding of the nation.

THEODORE ROOSEVELT.

Stability of national character goes with foothold on the soil.

DAVID STARR JORDAN.

## PREFACE.

IRRIGATION as it is related to the utilization of some of the great untouched resources of the United States is here discussed, and especial attention is devoted to the opportunities for making homes upon the vast extent of vacant public lands now waste and desolate. A somewhat elementary and popular description of irrigation and of the devices for obtaining and distributing water is given, including details of interest to persons who are beginning to give attention to the subject. More space is devoted to the crude, but effective, home-made contrivances than to the elaborate or expensive machinery purchased from manufacturers, for the success of irrigation depends most largely upon the rough-and-ready ingenuity of the first settlers in a new country in adapting their ways to the environment.

The writer has been continuously engaged for the last twelve years in conducting investigations of the extent to which the arid regions can be reclaimed by irrigation, ascertaining the cost and capacity of reservoirs, measuring the flow of rivers useful for power, irrigation, and other industrial



purposes, and mapping the artesian or underground waters. The attempt is here made to bring together, in as non-technical a manner as possible, the results of this study and experience.

Acknowledgment is due to the Director of the United States Geological Survey, Hon. Charles D. Walcott, for his interest in the matter and for permission to use illustrations and data from the files of the office, and to numerous friends and co-workers in the Survey who have generously aided in many ways. Especial recognition should be given to Major John Wesley Powell, the former Director, to whose foresight and energy is due the inauguration, in 1888, of the investigation by the Geological Survey of the extent to which the arid lands can be reclaimed by irrigation.

Thanks for material and assistance are given to Mr. Herbert M. Wilson, the author of the "Manual of Irrigation Engineering," of "Irrigation in India," etc.; to Mr. Arthur P. Davis, hydrographer for the Geological Survey and also for the Nicaragua and Isthmian Canal Commissions; to Mr. J. B. Lippincott and to Mr. A. L. Fellows, irrigation experts respectively for California and Colorado; to Mr. George H. Maxwell, of The National Irrigation Association; to Professor F. H. King, author of "Irrigation and Drainage"; to Mr. James D. Schuyler, author of "Reservoirs for Irrigation"; and to various writers on water supply and artesian conditions, particularly to Professor Israel C.

Russell, Mr. N. H. Darton, Professor T. C. Chamberlin, Professor Samuel Fortier, Professor E. C. Murphy, Mr. Frank Leverett, Professor E. H. Barbour, Professor Alfred C. Lane, Professor J. E. Todd, Professor Thomas U. Taylor, and Mr. George Otis Smith, all being connected to a greater or less degree with the investigation of the water resources of the United States.

Mention should also be made of various books which have been consulted: "The Conquest of Arid America," by William E. Smythe; "Irrigation Farming," by Lute Wilcox; "The Nation as a Landowner," by J. D. Whelpley, and pamphlets and reports by C. E. Grunsky, Marsden Manson, Elwood Mead, Clarence T. Johnston, E. J. Wickson, B. C. Buffum, J. C. Ulrich, R. H. Forbes, E. B. Voorhees, and others.

The literature on irrigation is now so extensive that few persons can claim to have more than a general knowledge of it. Free use has been made of all available sources of information, but no attempt has been made to assign credit for any particular item of information or illustration.

F. H. N.

January, 1902.



## PREFACE TO SECOND EDITION.

SINCE the time of the preparation of this book in the early spring of 1902, notable changes have taken place in the attitude of the public toward irrigation, and more rapid advances have been made in actual development than in the decade preceding. As a result of the efforts of President Roosevelt and of the continuous agitation of the subject by advocates of national control, Congress took up what was originally known as the Newlands Bill, and discussed, amended, and passed this during the spring of 1902. The measure, now known as the Reclamation Act, became a law on June 17, 1902. It is in many ways one of the most noteworthy pieces of legislation enacted by Congress in recent years. New principles are involved in national development, and the government has been committed to certain lines of internal improvements.

The President in his first message to Congress, delivered on December 3, 1901, struck the keynote (as shown on pages 393 to 396 in the latter part of this book). The friends of national irrigation were not slow in responding. In particular, great credit is due to the energy displayed by the National Irrigation Association, which, under the

## PREFACE TO SECOND EDITION. vii

leadership of Mr. George H. Maxwell, and with financial assistance given freely by Western railroads and Eastern manufacturing corporations, carried on a vigorous campaign of education. The result of these efforts was shown in the large support of the Reclamation Act by the rank and file of Congress against the advice and even opposition of the leaders of both the great political parties.

The law was immediately put into effect, and the Reclamation Service created under Mr. Charles D. Walcott, Director of the Geological Survey, known not only for his scientific work, but also as a successful organizer and business man. Under his leadership the operations have been pushed forward with energy. In the course of a little over three years most of the feasible projects of reclamation in the arid regions have been studied, work begun upon many of these, and the future policy placed upon a firm basis. In the meantime, there has been a general agitation as to the best use of the remaining public domain.

President Roosevelt, on October 22, 1903, appointed a commission to report on the condition, operation, and effect of the present land laws, and to recommend such changes as are needed to effect the largest practicable disposition of the public lands to actual settlers who will build permanent homes upon them, and to secure in permanence the fullest and most effective use of the resources



of the public lands. This commission consists of Governor W. A. Richards, Commissioner of the General Land Office, Gifford Pinchot, Forester, head of the Forest Service, and F. H. Newell, Chief Engineer of the Reclamation Service.

The commission made a first partial report on March 7, 1904, and a second report on February 13, 1905. These reports called attention to the fact that the present land laws are not suited to meet the conditions of the remaining public domain, and that their operation has not tended to promote home-making and the largest development of the country. On the contrary, they have been such as to lead to land monopoly and the restraint of settlement of agricultural lands by the most desirable class of citizens; namely, those who will live upon them, cultivate them, and become owners of small, well-cultivated tracts.

Out of this activity of agencies of the general government, there is growing a larger and better conception of the opportunities of the West, and of the need of broad control of the forests and of the water. It is believed that with this larger knowledge there will be a better grasp by the public of the duties of citizenship in this respect, and a more effective administration on the part of all responsible officers.

F. H. N.

January, 1906.

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