

In the subject index no titles are given, but references are given to the year and author, so that the corresponding title can be easily found in the chronological catalogue.

It is obvious that a scientific bibliography like this serves a very useful purpose to the student and investigator, especially when it is well arranged and possesses a high degree of completeness, as is the case here. With Sommerville's book at his command the worker in the field of non-Euclidean or  $n$ -dimensional geometry is unusually well equipped for referring quickly to the literature of his subject.

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*Report on the Dune-Areas of New Zealand, their Geology, Botany and Reclamation.*

By L. COCKAYNE, Ph.D., F.L.S., Department of Lands, New Zealand. Printed by John Mackay, government printer. 1911.

Because of extensive dune-areas and the impending danger to valuable lands from encroachment, the Dominion government commissioned Dr. Cockayne to conduct a careful investigation of the dune conditions in New Zealand and to embody certain recommendations as to the reclamation of the dune lands and the protection of threatened territory in a formal report. This report, which is an extension of the author's earlier researches, we now have from the government printer. The paper is divided into two parts; the first deals with the geology and botany of the dune-areas and the second with various methods of reclamation. In Part I. the geology of these dynamic habitats is very excellently handled under such subheads as: The Material of Dunes, Dune Building on the Coast, The Effect of Solid, Flexible and Inflexible Obstacles, and the Effect of Climate, General Topography of the Dune-areas in New Zealand, Movements of Dunes and Dune-sand. There are more than 300,000 acres of dune lands in North and South Islands, where occur chains of sandhills of irregular form, which are generally divided in places by basin-like hollows of greater or less extent. The wind plays a great part in constantly changing the form of

the dunes, the position of the hills, and in modifying the slope angles. Hills in all stages of growth and decay, and basins in the process of being hollowed out or being filled up appear on every side. The wider dune areas appear like seas of sand with the ridges as more or less stationary billows with their scanty vegetation.

Under "Botany" is treated such ecological matters as: Climatic Factors, Heat, Light, Moisture, Soil, Topography and Biotic Factors. The most characteristic plants with their growth-forms and adaptations are treated in considerable detail. The leading dune plants in New Zealand are: *Spinifex hirsutus* (Gramineæ); *Scirpus frondosus* (Cyperaceæ); *Euphorbia glauca* (Euphorbiaceæ); *Carex pumila* (Cyperaceæ); *Calyptegia Soldanella* (Convolvulaceæ); and *Arundo conspicua* (Gramineæ). These plants are distinguished as "sand-binders" in distinction to the following which are called "sand-collectors": *Caprosoma acerosa* (Rubiaceæ); *Pimelea arenaria* (Thymelæaceæ); *Cassinia leptophylla*, *C. fulvida*, *C. retorta* (Compositæ); *Festuca littoralis* (Gramineæ); *Calamagrostis Billardieri* (Gramineæ); and *Scirpus nodosus* (Cyperaceæ).

The commoner plant associations represented are: Sand-Grass Dunes, Pea Capra Dunes, Shrub Dunes, Lakes and Swamps, Dry Hollows and Stony Plain. The various dune species are noted in tabular form with various ecological notes. This list includes 147 species of which 82 are endemic, 43 Australian and 15 South American. Fifty-one families and 104 genera are represented in this number.

The methods in vogue the world over for the artificial fixation of dunes are based upon those which nature herself uses and these are here enumerated as fifteen "fundamental principles" with which plant ecologists are more or less familiar. Marram-Grass, *Ammophila arenaria*, and the Tree-Lupin, *Lupinus arboreus*, are noted as the best of the "sand fixers" for the region under consideration. The efficiency of these two species is compared in considerable detail. Under "Methods of Reclamation" the methods of preparing and

planting Marram-Grass and Tree-Lupin are discussed in detail and suggestions are included for the post-planting management of the plantations. The possibility of checking sand movement by means of sand-fences and protection belts is considerably elaborated. Protection belts are merely narrow bands of Marram set at the junction of the advancing sand and the invaded ground. Such a belt is efficient usually for only a few years unless it is constantly watched and repaired.

The report closes with a discussion of afforestation of the dunes, which method seems to the author to be the only means of establishing the desired static condition over the dune complex. Little tree-planting upon the dunes has been done in New Zealand under difficult conditions, but the method is strongly recommended. The more important trees and shrubs for dune afforestation in these islands are as follows: *Olearia Traversii*, *Pinus pinaster*, *Pinus halpensis*, *Araucaria excelsa*, *Cupressus macrocarpa*, *Pinus radiata* (most valuable), *Pinus muricata*, *Tamarix gallica*, *Lupinus arboreus*, *Acacia melanoxylon*, *Salix caspica*, *Populus deltoides*, *Populus balsamifera*, *Populus fastigiata* and *Alnus glutinosa*. Besides these species, all of them promising dune holders, *Pinus laricio*, *P. pinea*, *P. Coulteri* and *P. Strobus* grow "quite well" on the dunes of New Zealand. A final list of plants (over 200 species) suitable for dune cultivation in these islands contains useful information as to the habitat, growth-form, etc., for the various species, many of which are North American.

This very interesting and well-written paper is well illustrated by means of sixty-nine half-tones and three etchings, and includes a bibliography of sixty-six general works and seventy-three references to the literature of New Zealand Dunes.

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*Aerial Navigation. A Popular Treatise on the Growth of Air Craft and on Aeronautical Meteorology.* By ALBERT F. ZAHM. New York, D. Appleton & Co. 1911. 8vo. Pp.

xvii + 497; 58 illustrations in text and 32 full page plates.

Amid the flood of ephemeral popular and pseudo-scientific books on this subject which have appeared in England and America during the past two years, here is one that rests on a solid foundation, fit to carry the superstructure of subsequent progress. The author, distinguished as a pioneer investigator of aerodynamics in America, has been intimately acquainted with Langley, Chanute and the Wrights, and a close student of aeronautics in Europe. Therefore Dr. Zahm is eminently qualified to write a book, which in character resembles the reviewer's earlier and smaller "Conquest of the Air," a revised edition of which Dr. Zahm's later and more detailed publication seems to render superfluous. However, the most recent achievements in aeronautics chronicled in any book are already antiquated and surpassed when presented to the reader and conclusions based thereon require corresponding modification.

Authors naturally give prominence to those subjects with which they are most familiar and, therefore, while the reviewer accorded first place to the Ocean of Air, Dr. Zahm puts Aeronautical Meteorology last, having compiled this section largely from other authors and thereby somewhat neglected its status in this country. The two preceding divisions of the book are: the Growth of Aerostation, in which both spherical and dirigible balloons are considered, and the Growth of Aviation, treating of early attempts to fly, the modern glider and the power aeroplane. An appendix contains technical papers and three letters of Benjamin Franklin, written from Paris in 1783 describing the first balloons, which are reprinted from "The Conquest of the Air." The author refrains from prophecies concerning future developments of craft either lighter or heavier than air, since progress in the art of aerial navigation has been so rapid as to baffle conjecture concerning their ultimate applications.

In conclusion, it may be said that the work can be recommended, to either the lay or scientific reader, as admirable in its material