

7028

# THE HOME UNIVERSITY LIBRARY OF MODERN KNOWLEDGE

A COMPREHENSIVE SERIES OF NEW  
AND SPECIALLY WRITTEN BOOKS

---

EDITORS:

Prof. GILBERT MURRAY, D.Litt., LL.D., F.B.A.  
The Rt. Hon. HERBERT FISHER, LL.D., F.B.A.  
Prof. J. ARTHUR THOMSON, M.A., LL.D.  
Prof. WILLIAM T. BREWSTER, M.A.

---

256 pages.    -    -    In cloth or leather binding.

---

## HISTORY AND GEOGRAPHY

3. THE FRENCH REVOLUTION. By HILAIRE BELLOC, M.A. (With Maps.)
4. A SHORT HISTORY OF WAR AND PEACE. By G. H. PERRIS.
8. POLAR EXPLORATION. By Dr. W. S. BRUCE, F.R.S.E., Leader of the *Scotia* Expedition. (With Maps.)
12. THE OPENING-UP OF AFRICA. By Sir H. H. JOHNSTON, G.C.M.G., F.Z.S. (With Maps.)
13. MEDIEVAL EUROPE. By H. W. C. DAVIS, M.A. (With Maps.)
- THE PAPACY AND MODERN TIMES (1303-1870). By WILLIAM BARRY, D.D.
- HISTORY OF OUR TIME (1885-1913). By G. P. GOOCH, M.A.
- THE CIVILISATION OF CHINA. By H. A. GILES, LL.D., Professor of Chinese at Cambridge.
- THE DAWN OF HISTORY. By J. L. MYRES, M.A., F.S.A.
- THE HISTORY OF ENGLAND. By Prof. A. F. POLLARD, M.A. (With a Chronological Table.)
- CANADA. By A. G. BRADLEY.
- PEOPLES AND PROBLEMS OF INDIA. By Sir T. W. HOLDERNESS, K.C.S.I.
- ROME. By W. WARDE FOWLER, M.A.
- THE AMERICAN CIVIL WAR. By F. L. PAXSON.
- WARFARE IN BRITAIN. By HILAIRE BELLOC, M.A.
- MASTER MARINERS. By J. R. SPEARS.

61. NAPOLEON. By the Rt. Hon. HERBERT FISHER, LL.D., F.B.A.
66. THE NAVY AND SEA POWER. By DAVID HANNAY.
71. GERMANY OF TO-DAY. By CHARLES TOWER.
82. PREHISTORIC BRITAIN. By ROBERT MUNRO, M.A., M.D., LL.D. F.R.S.E. (Illustrated.)
91. THE ALPS. By ARNOLD LUNN, M.A. (Illustrated.)
92. CENTRAL AND SOUTH AMERICA. By Prof. W. R. SHEPHERD (Maps.)
97. THE ANCIENT EAST. By D. G. HOGARTH, M.A. (Maps.)
98. WARS BETWEEN ENGLAND AND AMERICA. By Prof. T. C. SMITH, M.A.
100. HISTORY OF SCOTLAND. By Prof. R. S. RAIT.
101. BELGIUM. By R. C. K. ENSOR. (Maps.)
105. POLAND. By Prof. W. ALISON PHILLIPS. (With Maps.)

## **LITERATURE AND ART**

2. SHAKESPEARE. By JOHN MASEFIELD.
27. ENGLISH LITERATURE: MODERN. By G. H. MAIR, M.A.
35. LANDMARKS IN FRENCH LITERATURE. By G. L. STRACHEY.
39. ARCHITECTURE. By Prof. W. R. LETHABY. (Illustrated.)
43. ENGLISH LITERATURE: MEDIEVAL. By Prof. W. P. KER, M.A.
45. THE ENGLISH LANGUAGE. By L. PEARSALL SMITH, M.A.
52. GREAT WRITERS OF AMERICA. By Prof. J. ERSKINE and Prof. W. P. TRENT.
63. PAINTERS AND PAINTING. By Sir FREDERICK WEDMORE. (With 16 half-tone Illustrations.) From the Primitives to the Impressionists.
64. DR. JOHNSON AND HIS CIRCLE. By JOHN BAILEY, M.A.
65. THE LITERATURE OF GERMANY. By Prof. J. G. ROBERTSON M.A., Ph.D.
70. THE VICTORIAN AGE IN LITERATURE. By G. K. CHESTERTON.
73. THE WRITING OF ENGLISH. By W. T. BREWSTER, A.M., Professor of English in Columbia University.
75. ANCIENT ART AND RITUAL. By JANE E. HARRISON, LL.D., D.Litt.
76. EURIPIDES AND HIS AGE. By GILBERT MURRAY, D.Litt., LL.D., F.B.A.
87. CHAUCER AND HIS TIMES. By GRACE E. HADOW.
89. WILLIAM MORRIS: HIS WORK AND INFLUENCE. By A. CLUTTON BROCK.
93. THE RENAISSANCE. By EDITH SICHEL.
95. ELIZABETHAN LITERATURE. By J. M. ROBERTSON, M.P.
99. AN OUTLINE OF RUSSIAN LITERATURE. By Hon. MAURICE BARING.
103. MILTON. By JOHN BAILEY, M.A.

## **SCIENCE**

7. MODERN GEOGRAPHY. By MARION I. NEWBIGIN, D.Sc.
9. THE EVOLUTION OF PLANTS. By Dr D. H. SCOTT, M.A., F.R.S. (Illustrated.)
17. HEALTH AND DISEASE. By W. LESLIE MACKENZIE, M.D.

18. INTRODUCTION TO MATHEMATICS. By A. N. WHITEHEAD, Sc.D., F.R.S. (With Diagrams.)
19. THE ANIMAL WORLD. By Prof. F. W. GAMBLE, F.R.S. With Introduction by Sir Oliver Lodge. (Many Illustrations.)
20. EVOLUTION. By Prof. J. ARTHUR THOMSON, M.A., and Prof. PATRICK GEDDES.
22. CRIME AND INSANITY. By Dr. C. A. MERCIER.
28. PSYCHICAL RESEARCH. By Sir W. F. BARRETT, F.R.S.
31. ASTRONOMY. By A. R. HINKS, M.A., Chief Assistant, Cambridge Observatory.
32. INTRODUCTION TO SCIENCE. By J. ARTHUR THOMSON, M.A.
36. CLIMATE AND WEATHER. By Prof. H. N. DICKSON, D.Sc.Oxon., M.A., F.R.S.E. (With Diagrams.)
41. ANTHROPOLOGY. By R. R. MARETT, M.A.
44. THE PRINCIPLES OF PHYSIOLOGY. By Prof. J. G. MCKENDRICK, M.D.
46. MATTER AND ENERGY. By F. SODDY, M.A., F.R.S.
49. PSYCHOLOGY, THE STUDY OF BEHAVIOUR. By Prof. W. McDUGALL, F.R.S., M.B.
63. THE MAKING OF THE EARTH. By Prof. J. W. GREGORY, F.R.S. (With 38 Maps and Figures.)
57. THE HUMAN BODY. By A. KEITH, M.D., LL.D. (Illustrated.)
58. ELECTRICITY. By GISEBERT KAPP, D.Eng. (Illustrated.)
62. THE ORIGIN AND NATURE OF LIFE. By Dr. BENJAMIN MOORE, Professor of Bio-Chemistry, University College, Liverpool.
67. CHEMISTRY. By RAPHAEL MELDOLA, F.R.S. Presents clearly the way in which chemical science has developed, and the stage it has reached.
72. PLANT LIFE. By Prof. J. B. FARMER, D.Sc., F.R.S. (Illustrated.)
78. THE OCEAN. A General Account of the Science of the Sea. By Sir JOHN MURRAY, K.C.B., F.R.S. (Colour Plates and other Illustrations.)
79. NERVES. By Prof. D. FRASER HARRIS, M.D., D.Sc. (Illustrated.) A description, in non-technical language, of the nervous system, its intricate mechanism, and the strange phenomena of energy and fatigue, with some practical reflections.
86. SEX. By Prof. PATRICK GEDDES and Prof. J. ARTHUR THOMSON, LL.D.
88. THE GROWTH OF EUROPE. By Prof. GRENWILLE COLE. (Illustrated.)

## **PHILOSOPHY AND RELIGION**

15. MOHAMMEDANISM. By Prof. D. S. MARGOLIOUTH, M.A., D.Litt.
40. THE PROBLEMS OF PHILOSOPHY. By the Hon. BERTRAND RUSSELL, F.R.S.
47. BUDDHISM. By Mrs. RHYS DAVIDS, M.A.
50. NONCONFORMITY: ITS ORIGIN AND PROGRESS. By Principal W. B. SELBIE, M.A.
54. ETHICS. By G. E. MOORE, M.A.
56. THE MAKING OF THE NEW TESTAMENT. By Prof. B. W. BACON, LL.D., D.D.
60. MISSIONS: THEIR RISE AND DEVELOPMENT. By Mrs. CREIGHTON.
68. COMPARATIVE RELIGION. By Prof. J. ESTLIN CARPENTER, D.Litt.
74. A HISTORY OF FREEDOM OF THOUGHT. By J. B. BURY, Litt.D., LL.D.

84. LITERATURE OF THE OLD TESTAMENT. By Prof. GEORGE MOORE, D.D., LL.D.
90. THE CHURCH OF ENGLAND. By Canon E. W. WATSON.
94. RELIGIOUS DEVELOPMENT BETWEEN THE OLD AND NEW TESTAMENTS. By Canon R. H. CHARLES, D.D., D.Litt.
102. HISTORY OF PHILOSOPHY. By CLEMENT C. J. WEBB.

## **SOCIAL SCIENCE**

1. PARLIAMENT. Its History, Constitution, and Practice. By Sir COURTENAY P. ILBERT, G.C.B., K.C.S.I.
5. THE STOCK EXCHANGE. By F. W. HIRST, Editor of *The Economist*.
6. IRISH NATIONALITY. By Mrs. J. R. GREEN.
10. THE SOCIALIST MOVEMENT. By J. RAMSAY MACDONALD, M.P.
11. CONSERVATISM. By LORD HUGH CECIL, M.A., M.P.
16. THE SCIENCE OF WEALTH. By J. A. HOBSON, M.A.
21. LIBERALISM. By L. T. HOBBHOUSE, M.A.
24. THE EVOLUTION OF INDUSTRY. By D. H. MACGREGOR, M.A.
26. AGRICULTURE. By Prof. W. SOMERVILLE, F.L.S.
30. ELEMENTS OF ENGLISH LAW. By W. M. GELDART, M.A., B.C.L.
38. THE SCHOOL: AN INTRODUCTION TO THE STUDY OF EDUCATION. By J. J. FINDLAY, M.A., Ph.D.
59. ELEMENTS OF POLITICAL ECONOMY. By S. J. CHAPMAN, M.A.
69. THE NEWSPAPER. By G. BINNEY DIBBLEE, M.A. (Illustrated.) The best account extant of the organisation of the newspaper press, at home and abroad.
77. SHELLEY, GODWIN, AND THEIR CIRCLE. By H. N. BRAILSFORD, M.A.
80. CO-PARTNERSHIP AND PROFIT-SHARING. By ANEURIN WILLIAMS, M.A.
81. PROBLEMS OF VILLAGE LIFE. By E. N. BENNETT, M.A.
83. COMMON-SENSE IN LAW. By Prof. P. VINOGRADOFF, D.C.L.
85. UNEMPLOYMENT. By Prof. A. C. PIGOU, M.A.
96. POLITICAL THOUGHT IN ENGLAND: FROM BAÇON TO HALIFAX. By G. P. GOOCH, M.A.
104. POLITICAL THOUGHT IN ENGLAND: FROM SPENCER TO THE PRESENT DAY. By ERNEST BARKER, M.A.
106. POLITICAL THOUGHT IN ENGLAND: THE UTILITARIANS FROM BENTHAM TO J. S. MILL. By W. L. DAVIDSON, M.A., LL.D.

*Many other future volumes in preparation.*

---

**LONDON: WILLIAMS AND NORGATE**

*And of all Bookshops and Bookstalls.*

HOME UNIVERSITY LIBRARY  
OF MODERN KNOWLEDGE

26

# AGRICULTURE

By WILLIAM SOMERVILLE, M.A., D.Sc.

LONDON

WILLIAMS & NORGATE

---

HENRY HOLT & Co., New York

CANADA: WM. BRIGGS, Toronto

INDIA: R. & T. WASHBOURNE, LTD.



HOME  
UNIVERSITY  
LIBRARY  
OF  
MODERN KNOWLEDGE

*Editors :*

HERBERT FISHER, M.A., F.B.A.

PROF. GILBERT MURRAY, D.LITT.,  
LL.D., F.B.A.

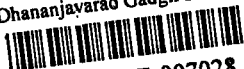
PROF. J. ARTHUR THOMSON, M.A.

PROF. WILLIAM T. BREWSTER, M.A.  
(Columbia University, U.S.A.)

NEW YORK  
HENRY HOLT AND COMPANY



Dhananjavarao Gadgil Library



GIPE-PUNE-007028

# AGRICULTURE

BY

**WILLIAM SOMERVILLE**

M.A., OXFORD, CAMBRIDGE, AND DURHAM;  
D.SC., OXFORD AND DURHAM; D.GC., MUNICH;  
B.SC., EDINBURGH; SIBTHORPIAN PROFESSOR  
OF RURAL ECONOMY, AND FELLOW OF ST.  
JOHN'S COLLEGE, IN THE UNIVERSITY OF  
OXFORD.

LONDON  
**WILLIAMS AND NORGATE**

J

F7

*Printed by*  
MORRISON & GIBB LIMITED  
*Edinburgh*

7028

## PREFACE

THE object of this volume is to discuss the fundamental principles underlying the practice of agriculture. It is, in the main, an introduction to crops and cropping, and contains the sort of information that a farmer may be expected to possess who aims at cultivating his fields and manuring his crops intelligently. The special requirements of the readers for whom the series is intended have constantly been borne in mind; and it is hoped that, supplemented by the selection of the works mentioned at the end, the little volume may be useful for those who have to gather their knowledge without much aid from laboratories and lecture rooms.

W. S.

# CONTENTS

| CHAP. |                                                                       | PAGE |
|-------|-----------------------------------------------------------------------|------|
| I     | THE FORMATION OF SOIL . . . . .                                       | 9    |
| II    | THE PROPERTIES OF SOIL . . . . .                                      | 24   |
| III   | THE MAIN TYPES OF SOIL . . . . .                                      | 47   |
| IV    | AMELIORATION AND IMPROVEMENT OF LAND .                                | 73   |
| V     | THE PRINCIPLES OF MANURING, THE NITRO-<br>GENOUS MANURES . . . . .    | 99   |
| VI    | PHOSPHATIC, NITROGENOUS-PHOSPHATIC, AND<br>POTASSIC MANURES . . . . . | 125  |
| VII   | THE EFFECTIVE USE OF ARTIFICIAL MANURES                               | 161  |
| VIII  | FARMYARD MANURE . . . . .                                             | 173  |
| IX    | ROTATION OF CROPS . . . . .                                           | 188  |
| X     | SEED . . . . .                                                        | 219  |
|       | BIBLIOGRAPHY . . . . .                                                | 252  |
|       | INDEX . . . . .                                                       | 254  |

# BIBLIOGRAPHY

## SOILS

HALL.—*The Soil* (London, John Murray). The whole subject is handled in a masterly way. Whether as a text-book or a laboratory guide, it should be in the hands of every agricultural student.

HALL AND RUSSELL.—*Agriculture and Soils of Kent, Surrey, and Sussex* (published by the Board of Agriculture). An agricultural soil-survey of the South-East of England, where the relationship of different types of farming to the geological conditions is dealt with in an interesting and practical manner.

KING.—*The Soil* (London, Macmillan & Co.). An American work smaller than the first, dealing more particularly with the physical aspects of the subject.

MACDONALD.—*Dry Farming* (Werner Laurie). A book by a man who has carefully studied the conservation of water for agricultural purposes in districts of low rainfall in North America and South Africa.

MARR.—*Agricultural Geology* (Methuen & Co.). An excellent text-book of geology in its bearings on agriculture. Traces the relationship of soils to geological strata, and contains much useful information in regard to geological maps.

WARINGTON.—*Physical Properties of Soil* (The Clarendon Press). A series of lectures delivered in Oxford, in which the subject is handled with the author's well-known thoroughness.

## MANURING, CROPS, SEEDS, AND GENERAL

ADIE AND WOOD.—*Agricultural Chemistry* (Kegan Paul, Trench, Trübner & Co.). Two small volumes, containing, like some of the books below, information

# INDEX

- Amelioration of land, 73.
- Ammonia and nitrogen, Relation between, 121.
- Artificial manures, Use of, 161.
- Atavism, 234.
- Attraction of soil, Surface, 29.
- Bare fallowing, 96.
- Barley in rotation, 211.
- Basic Slag and Superphosphate, Relative values of, 126.
- Basic Slag, Valuation of, 138.
- Blood Meal, 125, 147.
- Bone Ash, 137.
- Bone-manures, 144.
- Breeding plants, 232.
- Broadcasting seed, 244.
- Calcareous soil, Properties of, 58.
- Calcium cyanamide, 124.
- Capillarity in soil, 28, 30.
- Carbonic acid as a weathering agent, 20.
- Catch-cropping, 212.
- Chalk soil, Properties of, 58.
- Changing seed, 223.
- Citric-soluble phosphate, 141.
- Clay burning, 87.
- Clay soil, Properties of, 55.
- Cleanness of seed, 221.
- Clover sickness, 133, 193, 200.
- Cohesiveness of soil, 24.
- Denitrification, 65.
- Density of seeding, 248.
- Disease-resisting plants, 230.
- Dominant characters, 242.
- Drainage, Effects of, 76.
- Drainage of land, 74.
- Dried blood, 125, 147.
- Drilling seed, 244.
- Dry farming, 31.
- Dung, Output of, 177.
- East Lothian rotation, 208.
- Essential elements of plant food, 106.
- Experiments, Field, 168.
- Fallowing, Bare, 96.
- Farming, Dry, 31.
- Farmyard manure, 173.
- Field trials, 168.
- Finger-and-toe, 93, 167, 193, 200.
- Fish guano, 147.
- Formation of soil, 9.
- Four-course shift, 203.
- Frost uprooting plants, 77.
- Frost a weathering agent, 17.
- Gas lime, 94.
- Glaciers as soil-forming agents, 23.
- Grass land, Effects of phosphates on, 132.
- Green manuring, 51.
- Ground lime, 92.
- Guano, Fish, 147.
- Guano, Ichaboe, 160.
- Guano, Peruvian, 160.
- Guano, Phosphatic, 147.
- Heat, Absorption of, 41.
- Heat of oxidation, 43.
- Heat of soil, 38.
- Heat, Sources of, 42.
- Holderness rotation, 209.
- Humus, Properties of, 60.
- Hydration as a weathering agent, 14.
- Ichaboe guano, 160.
- Improvement of land, 73.

- Potatoes, Seed, 227.  
 Precipitated phosphate, 137.  
 Prepotency, 236.  
 Properties of soil, 24.  
 Purity of seed, 220.  
 Rape meal, 125.  
 "Real Value" of seed, 222.  
 Recessive characters, 242.  
 Reversion, 234.  
 Reverted phosphate, 167.  
 Roots as weathering agents, 22.  
 Rotations, 188.  
 Rotations, Types of, 200.  
 Sandy soil, Properties of, 48.  
 Seed, 219.  
 Seed, Change of, 223.  
 Seed potatoes, 227.  
 Seeding, Density of, 248.  
 Selection of plants, 236.  
 Sickness of clover, 133, 193, 200.  
 Slag, Valuation of basic, 138.  
 Soil, capacity to hold water, 27.  
 Soil, Capillary power of, 28.  
 Soil, Properties of calcareous, 58.  
 Soil, Properties of clay, 55.  
 Soil, Cohesiveness of, 24.  
 Soil-cover of seed, 245.  
 Soil, Formation of, 9.  
 Soil, Properties of humus, 60.  
 Soil, Properties of, 24.  
 Soil, Properties of sandy, 48.  
 Soil, Types of, 47.  
 Specific heat, 39.  
 "Sports," 234.  
 Stassfurt mines, 147.  
 Sulphate of ammonia and nitrate of soda compared, 111.  
 Sulphate of ammonia removes lime, 59, 116.  
 Sulphate of ammonia, Valuation of, 119.  
 Sulphate of potash, 149.  
 Superphosphate, Valuation of, 142.  
 Superphosphate and basic slag, 126.  
 Surface attraction of soil, 29.  
 Three-field rotations, 202.  
 Turnip seed, Raising, 214, 224.  
 Types of soil, 47.  
 Unit valuations, 120, 145, 149.  
 Valuation of basic slag, 139.  
 Valuation of bone manures, 145.  
 Valuation of farmyard manure, 175, 180.  
 Valuation of nitrate of soda, 118, 120.  
 Valuation of phosphatic manures, 137.  
 Valuation of potash manures, 149.  
 Valuation of seed, 223.  
 Valuation of sulphate of ammonia, 119.  
 Valuation of superphosphate, 142.  
 Variation of plants, 234.  
 Variations of temperature as a weathering agent, 13.  
 Warping, 90.  
 Water as a carrier of plant food, 34.  
 Water condensed from atmosphere, 37.  
 Water depresses temperature, 39, 76.  
 Water-holding power of soil, 27.  
 Water as a weathering agent, 14.  
 Weathering agents, 13.  
 Wheat breeding, 241.  
 Wheat rust, 230.  
 White clover, Effects of phosphates on, 129.  
 Worms, Action of, 71.