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The Cambridge Manuals of Science and Literature

THE NATURAL HISTORY OF CLAY

CAMBRIDGE UNIVERSITY PRESS
FETTER LANE, E.C.
C. F. CLAY, Manager

100, PRINCES STREET
WILLIAM WESLEY AND SON, 28, ESSEX STREET, STRAND
A. ASHER AND CO.
F. A. BROCKHAUS
G. P. PUTNAM'S SONS

MACMILLAN AND CO., Ltd.

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The Natural History of Clay

THE NATURAL
HISTORY OF CLAY

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Handbook*, etc., etc.

Cambridge:
at the University Press
New York:
G. P. Putnam's Sons
1912

PRINTED BY JOHN CLAY, M.A.
AT THE UNIVERSITY PRESS

With the exception of the coat of arms at the foot, the design on the title page is a reproduction of one used by the earliest known Cambridge printer, John Siberch, 1521

PREFACE

Both as raw materials and in the form of pottery, bricks, tiles, terra-cotta and many other articles of use and ornament, clays are amongst the most important rock products. Yet the origin of the substances we know as 'clay,' the processes occurring in its formation and the causes of some of the most important of its characteristics The Natural History of Clay are of such a nature that it is remarkable that its use should have become so extended in the arts and sciences, while we know so little of its properties when in a pure state.

In the following pages an attempt has been made The Natural History of Clay to state in a simple form an outline of our present knowledge of the subject and to indicate the problems which still lie before us.

The experimental solution of these problems is rendered peculiarly difficult by the inertness of the materials at ordinary temperatures and the ease with which the clay molecule appears to break down into its constituent oxides at temperatures approaching red heat or as soon as it begins to react with alkaline or basic materials.

Another serious difficulty is the highly complex nature of that property known as 'plasticity' to which many clays owe their chief value. For many years this has been regarded as an elementary property such as hardness, cohesion or colour, but it is now known to be The Natural History of Clay of so elusive a nature as almost to defy measurement with any degree of accuracy.

The thoroughness with which the The Natural History of Clay methods of physical chemistry have been applied to geological and mineralogical problems during recent years has been of very great assistance to the student of clay problems, as will be seen on studying some of the works mentioned in the short bibliography at the end of the present volume. When the principles

of hydrolysis, ionization, mass reaction and reactional velocity have been applied in still further detail to the study of clays, our knowledge of their natural history will increase even more rapidly than it has done during the past few The Natural History of Clay years.

No industry exercises The Natural History of Clay so great a fascination over those engaged in it as do the various branches of clayworking; no other substance offers so many problems of such absorbing interest to the artist, the craftsman, the geologist, the chemist and the general student of nature, whilst the differences in legal opinion as to the nature of clay could themselves occupy a volume far larger than the present one.

A. B. S.

The White Building,

Sheffield.

November 1911.

THE CHIEF CLAY ROCKS (arranged geologically)

Tertiary	The Natural History of Clay	Recent The Natural History of Clay (<i>all</i>)
	Pliocene	<i>clay, silt, brick earths, boulder clay</i>
	Miocene	<i>(brick earths, ball</i>
	Oligocene	<i>clays, coarse</i>
		<i>pottery clays)</i>

	Eocene	
The Natural History of Clay	Secondary	Cretaceous (<i>cement clays, brick clays</i>)
		Oolitic (<i>brick and tile clays</i>)
	Primary	Triassic (<i>brick, tile and terra-cotta clay</i>)
		Permian (<i>brick, tile and flower-pot clay</i>)
The Natural History of Clay		Carboniferous (<i>brick clays, fireclays, g</i>)
		Devonian
		Silurian
		Ordovician
		Cambrian
		Pre-Cambrian
		Igneous Rocks occur on several horizons <i>and kaolins</i>)

(In the above Table only the clay-bearing strata are mentioned. The formations named consist chiefly of other rocks in which the clays form strata of variable thickness.)

CHAPTER I

INTRODUCTION. THE CHEMICAL AND PHYSICAL PROPERTIES OF CLAY

The chief uses of clay have been recognized since the earliest periods of civilization; the ancient Assyrian and Egyptian records contain numerous references to the employment of clay for the manufacture of bricks The Natural History of Clay and for fulling or whitening cloth.

Clays are distributed so widely and in many cases The Natural History of Clay are so readily accessible that their existence and some of their characteristics are known in entirely uncivilized regions. The use of certain white clays as a food, or at any rate The Natural History of Clay as a means of staving off hunger, is common among some tribes of very primitive peoples. The Natural History of Clay The more important uses of clays for building and other purposes are naturally confined to the more civilized nations.

The term *clay* (A.S. *cloeg*; Welsh *clai*; Dutch *kley*) although used in a scientific sense to include a variety of argillaceous earths (Fr. *argile* = clay) used in the manufacture of bricks, tiles, pottery and ceramic products (Gr. *keramos* = potter's earth) generally, is really a word of popular origin and use. Consequently, it is necessary to bear in mind, when considering geological or other The Natural History of Clay problems of a scientific The Natural History of Clay nature, that this term has been incorporated into scientific terminology and that its use in this connection not infrequently leads to confusion. In short, whilst almost every dictionary includes one or more definitions of clay, and most text-books on geology, mineralogy, and allied sciences either attempt a definition or assume the reader's knowledge of one, there is no entirely The Natural History of Clay satisfactory limitation in regard to the substances which may or may not be included under the term.

Clay is a popular term for a variety of substances of very varied origins, of great dissimilarity in their composition and in many of their chemical and physical properties, and differing greatly in almost every conceivable respect. It is commonly supposed that all clays are plastic, but some of the purest china clays are almost devoid of this property and The Natural History of Clay some of the most impure earths used The Natural History of Clay for brickmaking possess it in a striking degree. Shales, on the one hand—whilst clearly a variety of clay—are hard and rock-like, requiring to be reduced to powder and very thoroughly mixed with water before they become plastic; many impure surface deposits, on the other hand, are so highly plastic as to necessitate the addition of other (sandy) materials before they can be used for the manufacture of bricks and tiles.

Attempts have been made to include in the term clay 'all minerals capable of becoming plastic when moistened or mixed with a suitable quantity of water,' but this definition is so wide as to be almost impracticable, and leads to the inclusion of many substances which have no real connection with clays. The limitation of the use of the word 'clay' to the plastic or potentially plastic The Natural History of Clay materials of any single geological epoch is also impracticable, for clays appear to have been deposited in almost every geological period, though there is some difference of opinion as to the time of the formation of certain clays known as *kaolins*.

Clay is not infrequently termed a

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