# THE ORDER OF NATURE: AN ESSAY

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## AN ESSAY

BY

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# PREFACE

*La nature est un ordre . . . dont l'ensemble titue une puissance inaltérable dans son essence, jettie dans tous ses actes, et constamment agissant toutes les parties de l'univers." . . . "un ordre . capable de donner successivement l'existence à s d'êtres divers" . . . "cette puissance qui fait it de choses, et qui cependant est constamment rnée à ne faire que celles-là."*

LAMARCK, *Histoire naturelle des animaux sans vertèbres.*

THE study of adaptation, of which Lamarck is the great originator, has not yet won for itself a secure scientific foundation or led to clear and unequivocal interpretations of nature. Although the facts which this study presents are both universal and important, biologists have neither agreed upon their place in the theory of evolution nor discovered any principle by which they may be even unified.

This failure of our modern science is not hard to understand, and may fairly be attributed, in part at least, to the lack of a systematic study of *adaptability*; which at bottom is a physical and chemical problem, uncomplicated by the riddle of life.

For beneath all the organic structures and functions are the molecules and their activities. These it is that have been moulded by the process of evolution, and these no less have formed the environment.

I beg the reader to bear this in mind and constantly to remember one simple question: What are the physical and chemical origins of diversity among inorganic and organic things, and how shall the adaptability of matter and energy be described? He may then see his way through all the difficulties which philosophical and biological thought have accumulated around a problem that in the final analysis belongs only to physical science, and at the end he will find a provisional answer to the question.

L. J. H.

CAMBRIDGE, MASSACHUSETTS,
March, 1916.

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# THE ORDER OF NATURE

# I

## INTRODUCTION

MANY of the characteristics of inorganic nature, like the stability of the solar system and the enduring movements of the waters of the earth, are the very condition of existence for life as we know it and the source of diversity in organic evolution. This is perhaps one of the oldest interpretations of nature. But since Darwin's time the fitness of the environment has only occasionally aroused passing comment without ever entering the main current of scientific thought. And yet, whatever may be the final judgment of natural science upon either organic or inorganic harmonies, biological fitness is manifestly a mutual relationship. For, however present order may have developed out of past confusion, the organism and the environment each fits and is fitted by the other.

In a recent book [1] I have tried to recall attention to the many interesting peculiarities of the environment and to state the facts concerning the fitness of the inorganic world for life. This has turned out to be more notable and extensive than biologists had supposed, and more important in

[1] *The Fitness of the Environment.* New York, The Macmillan Co., 1913.

determining the universal characteristics of living organisms. The very nature of the cosmic process and of the physical and chemical phenomena of matter and energy bring about not only stability of the solar system, but very great stability of land and sea. Thus the temperature of the earth is more equable than it could be if the composition of the surface of the earth were other than it is. Thus the alkalinity of the ocean possesses a constancy which is nearly perfect, and this depends upon certain unique properties of carbonic acid. Thus the currents of the atmosphere and of the ocean, the fall of rain and the flow of streams are almost ideally regular, and are so only because water is different from any other substance.

Secondly, the properties of water cause a mobilization all over the earth of most of the chemical elements in very large quantities, and no other substance could so effectively accomplish this result. Once mobilized, these elements penetrate everywhere, borne by water, and the penetrating qualities of water are unique. In this manner the whole earth has become habitable.

Even more significant appear what the chemist calls the properties of the three elements, hydrogen, oxygen, and carbon, from which water and carbonic acid are formed. These are the most active of all elements (if we take account of both intensity and variety of activity), their compounds are the