

**BULLETIN NO. 210, SERIES C, SYSTEMATIC  
GEOLOGY AND PALEONTOLOGY, 61.  
DEPARTMENT OF THE INTERIOR UNITED STATES  
GEOLOGICAL SURVEY. THE CORRELATION OF  
GEOLOGICAL FAUNAS: A CONTRIBUTION TO  
DEVONIAN PALEONTOLOGY**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649495603

Bulletin No. 210, Series C, Systematic Geology and Paleontology, 61. Department of the Interior  
United States Geological Survey. The Correlation of Geological Faunas: A Contribution to  
Devonian Paleontology by Henry Shaler Williams

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.  
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

[www.triestepublishing.com](http://www.triestepublishing.com)

**HENRY SHALER WILLIAMS**

**BULLETIN NO. 210, SERIES C, SYSTEMATIC  
GEOLOGY AND PALEONTOLOGY, 61.  
DEPARTMENT OF THE INTERIOR UNITED STATES  
GEOLOGICAL SURVEY. THE CORRELATION OF  
GEOLOGICAL FAUNAS: A CONTRIBUTION TO  
DEVONIAN PALEONTOLOGY**



Bulletin No. 210

Series C, Systematic Geology and Paleontology, 61

DEPARTMENT OF THE INTERIOR  
UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

---

THE  
CORRELATION OF GEOLOGICAL FAUNAS

A CONTRIBUTION TO DEVONIAN PALEONTOLOGY

BY

HENRY SHALER WILLIAMS



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1903

## CONTENTS.

	Page
INTRODUCTION .....	5
CHAPTER I.—The principles of correlation .....	10
Importance of correlation .....	10
Correlation division of the United States Geological Survey .....	10
Dual nomenclature .....	11
Definitions and nomenclature of faunal paleontology .....	13
Animal and plant aggregates .....	13
Zoological and botanical classification .....	15
Distribution and range .....	16
Geological faunas and their nomenclature .....	20
Nomenclature of formations .....	27
Faunal aggregates .....	28
CHAPTER II.—The geological expression of faunal migrations .....	33
Migration as a stimulus to variation .....	40
CHAPTER III.—Faunal dissection of Middle and Upper Devonian of the New York province .....	42
Introduction of a faunal classification of the Devonian system .....	45
Revised classification of faunas .....	48
The statistics and the plan of discussion .....	49
Hamilton formation and <i>Tropidoleptus carinatus</i> fauna .....	50
<i>Tropidoleptus carinatus</i> fauna of eastern counties of New York and Pennsylvania .....	51
Distributional values of the species .....	52
Frequency values of the species .....	52
Range values of the species .....	53
Cayuga Lake section .....	54
Eighteenmile Creek section .....	57
Construction of a standard list of the dominant species of the <i>Tropido-</i> <i>leptus carinatus</i> fauna .....	58
Effect of additional statistics .....	62
Statistics based on analysis of the zones of the Livonia salt shaft .....	63
Hamilton formation in Ontario, Canada .....	64
Hamilton formation in Michigan .....	65
Hamilton formation in Wisconsin .....	65
Hamilton formation in southern Illinois .....	66
Sellersburg formation in Indiana .....	66
Romney formation in western Maryland .....	67
Absence of <i>Tropidoleptus</i> fauna in other regions .....	68
Post-Hamilton formations and their faunas in New York province .....	68
Fauna of eastern extension of Portage formation .....	71
Fauna of Ithaca formation as expressed in the typical locality at Ithaca, N. Y. ....	73
<i>Productella speciosa</i> fauna .....	76
Immigrant species of Ithaca formation .....	78
Mutation and correlation of the faunas .....	81

	Page.
CHAPTER III.—Continued.	
Chemung formation and its fauna .....	82
<i>Spirifer disjunctus</i> fauna .....	83
Recurrence of the <i>Tropidoleptus</i> fauna in the epoch of the <i>Spirifer disjunctus</i> fauna .....	89
Marine fauna above Oneonta sandstone of eastern New York .....	92
CHAPTER IV.—Shifting of faunas .....	97
Evidence of shifting of faunas associated with deposition of Oneonta sandstone .....	97
Principles involved in shifting of geological faunas .....	103
Biological consequences of shifting of faunas .....	105
Effect of shifting of faunas on classification of geological formations ..	108
Black shale sediments .....	109
Portage formation sediments .....	110
Fossiliferous shaly sediments of Ithaca group .....	110
Red sandstone sediments .....	110
Faunal shifting and correlation .....	112
CHAPTER V.—Equivalency as interpreted by geologists .....	117
Diversity of interpretation .....	117
Correlation of Devonian formation of Ohio, western New York, and eastern New York .....	120
CHAPTER VI.—The bionic value of fossils .....	124
General statement .....	124
The terms "species," "race," and "generation" .....	127
Order of magnitude of bionic units .....	128
Revised definition of the terms "fauna" and "faunule" .....	131
The bionic time scale .....	132
BIBLIOGRAPHY .....	135
INDEX .....	141

---

## ILLUSTRATION.

---

PLATE I. Comparative chart of the Middle and Upper Devonian formations of Ohio, Pennsylvania, and New York .....	120
--	-----

# THE CORRELATION OF GEOLOGICAL FAUNAS.

---

By HENRY SHALER WILLIAMS.

---

## INTRODUCTION.

In the year 1881 I began a series of investigations for the purpose of discovering the laws which determine the association of fossils in faunal aggregates and their modifications in relation to geographical distribution and to vertical succession, in order to apply those laws as guides to the correlation and classification of geological formations. While these investigations have been in progress many other workers have joined in the search. Many statistics have been gathered, and observations have been extended over a wide field. A few important results have been attained, and the nature of the problem is now more clearly understood than at the outset. It seems, therefore, that this is a fitting time to review the progress already made, and to point out the more prominent results achieved and the paths along which future investigations may be guided with most promise of success.

When the investigations were begun it was already known that geological formations were marked by species of fossils differing greatly for each succeeding formation. In the early days of geology this difference was supposed to be due to extinction of old and the appearance of new forms for the first time with the income of each new formation. With this conception was associated the idea of sharp distinction between formations, each of which had a characteristic set of "Leitfossilien." The prevalence of this latter view dominated all the literature; and the presence, in a newly exploited section of rocks, of a species supposed to be characteristic of a given formation was assumed to be sufficient evidence of the presence of the formation in the new section. On this basis of determination it had become a fact that under the name of each formation there was catalogued a group of species collected from widely separated regions and found in different kinds of rocks, all of them being thus lumped together as the characteristic species of the formation considered.

At the outset of the present inquiry it was evident that, in order to learn how the modification of species has actually taken place, the



composition of the fauna of a formation must be critically examined, the actual association of species in each bed of rock must be analyzed, and the succession of species traced step by step through continuous sections.

My first experiments in this field of investigation were with the faunas exhibited in the rocks in the neighborhood of Ithaca, N. Y. In these rocks, which were classified as Portage and Chemung, a number of zones filled with separate faunules<sup>a</sup> were discovered, some of which were entirely different from others in the series, but the order of their succession was readily distinguished in each of the rock sections for miles about. This integrity of the faunules in geographical distribution, over at least the few miles of area at first explored, together with the sharp differences in the composition of successive faunules, suggested a clue to the solution of the larger problems involved.

When, again, on comparison of two sections running through the same portion of the geological column it was found that a formation which was clearly defined in one section was missing in the other, it was customary (in the absence of evidence of unconformity) to explain the absence of the missing member in the second section by the supposition that it had gradually thinned out until it disappeared. Its place in the second column was recognized, but the thickness of its sediments was reduced to nothing or to an inappreciable amount. Correlation of diverse formations being made on this basis, the general geological column was constructed of a single series of superimposed formations, diversity of fossil contents standing for difference of formations. Each formation was thus forced to take some particular place in a single geological column.

As knowledge of the faunas increased, the failure to establish the exact identity of a newly discovered fauna with any of the faunas of the standard column already described led to the intercalation of the formation containing it between the standard formations whose faunas most closely resembled it. That there might be living at the same time two entirely distinct faunas whose records were buried and preserved within a few miles of each other was a possibility that was not then seriously contemplated. I refer to marine faunas, for the distinction between marine, fresh-water, and land conditions was clearly recognized; but almost never were faunas from diverse envi-

<sup>a</sup>The term "faunule" is here and in the following pages used to distinguish an aggregate of fossils associated in a single stratum or zone from the total aggregate of species (the fauna) distributed through a greater or less thickness of strata, each faunule containing a considerable proportion of the same species, but not always in the same combination or proportionate abundance. The association in the faunule is supposed to be an expression of the temporary adjustment to environment and to each other of the living species—an adjustment determined by the relative vigor of each species; whereas the fauna is an aggregate of species determined by several quite divergent conditions and factors, the fauna living on so long as these conditions and factors remained sufficiently intact to permit it to preserve its general characteristics and the dominant species to maintain their relative place in the fauna, though for a time suffering more or less variation of composition, due to local and temporary conditions. (See page 131.)

ronments present in sections so nearly contiguous to one another as to occasion confusion in correlation.

The case of the Old Red sandstone and the marine Devonian was a conspicuous exception to the practice indicated. In this case the marine faunas of the Devonian limestone were recognized by Lonsdale as holding an intermediate place between the Silurian and Carboniferous marine faunas; and the Old Red sandstones were known to occupy the interval between these two systems; hence the equivalency of a series of marine beds with a series of estuary or fresh-water beds containing an entirely different fauna was established. But, in general, in the lesser cases, where faunas of the same kind of organisms are concerned, it has been the prevailing practice of geologists everywhere to assume that formations must be classified in a single column. Since the correlation and identification of formations has depended on their fossil contents, this practice has resulted virtually in the assumption that fossil faunas whose identity can not be established must be either older or younger than the standard faunas to which they are most closely related.

It was in the belief that this practice was erroneous and was leading to false conceptions of geological history that the investigations here described were begun. But the difficulties in the way of demonstrating the fallacy of the practice were great. Since the fossils are the only means by which the identity of two formations found at a distance from each other can be established, it seemed like a contradiction to say that two formations with unlike faunas may be identical in age. In order to test the question, it was necessary to take a region in which, for considerable distance, the structure of the rocks was so simple and so little disturbed that the stratigraphical equivalency of the beds could be traced with a high degree of certainty from one end to the other, independently of the fossil contents. Such a set of conditions appeared in the Devonian rocks of New York, Pennsylvania, and eastern Ohio. It was proposed to make a series of sections cutting through the same general part of the geological column, at intervals of about 50 miles, extending eastward as far as the Hudson River Valley and westward as far as the Cuyahoga Valley at Cleveland, the first trial section having been made along the meridian running through Ithaca, N. Y., in 1881-82. Minute study of each section was to be made; the fossils were to be collected from each fossiliferous zone, the position of which was to be carefully noted, and the faunules so collected were to be separately analyzed and listed. Intermediate traverses were to be made to tie together the sections by clearly recognized continuous strata, so that the stratigraphic equivalency of the parts of each section could be established with certainty. The work was begun privately in Cornell University, but the necessity of transgressing State lines led to the association of the university with the United States Geological Survey, by whose official

sanction and financial assistance the necessarily slow process of accumulating the statistics has proceeded. At the outset Major Powell, then Director of the Survey, and Mr. Charles D. Walcott, then in charge of Paleozoic paleontology, gave their valued encouragement. The task was a large one, but its importance was also great. A single person could not expect in a lifetime to execute the whole work required to solve the problem, and therefore graduate students at Cornell University, and later at Yale, seeking practice in geological investigation, were interested in the work, and original research along these lines was intrusted to them. A large amount of statistics has been thus gathered.

These investigations have now been going on for twenty years, and numerous geologists have taken part in them. In the year 1885 a brief report of the general results attained up to that time was made before the American Association for the Advancement of Science.<sup>a</sup> At that time ten of the sections had been run, viz: Cuyahoga, Ohio; Painesville, Ohio; Girard, Pennsylvania; Chautauqua, New York-Pennsylvania; Genesee, New York-Pennsylvania; Canandaigua, New York; Cayuga, New York; Tioughnioga, New York; Chenango, New York; Unadilla, New York. The fossils were collected from the separate faunules, and certain general conclusions were then evident. Since then Messrs. Prosser, Clarke, Darton, and others have pushed the sections farther east, and they have been extended, with the aid of Messrs. Van Ingen, Weller, and Kindle, into Missouri, Arkansas, Kentucky, Indiana, Virginia, and West Virginia. Messrs. Geiger and Sayles have added collections from the Appalachian region. The Maryland geological survey is adding to the statistics for Maryland, and investigations are now going on in many other regions of the United States. Preliminary study of most of the collections has been made. The investigations for some part of the field have been carried much further than others, but the undertaking has now reached a stage in which it is possible to exhibit the general bearings of the results upon the whole field of stratigraphical geology and to state the principles upon which the investigations have proceeded, as well as to suggest at least what may be expected in the future, when the facts shall be fully elaborated.

In the preparation of this report I have been obliged to refer often to the statistics already gathered. Some of them, accumulated by myself or under my direction, have been published. Other statistics, in the form of unpublished notes, compiled in the course of elaborating the collections, have also been freely consulted. In addition to these sources, the reports of others working in the same field have been used, and for all such statistics I am deeply grateful to the contributing authors. The bibliographic list is large, and may be

<sup>a</sup>On the classification of the Upper Devonian: Proc. Am. Assoc. Adv. Sci., Vol. XXXIV, 1886, pp. 222-234.