THE ECHINODERM FAUNA OF AUSTRALIA

Its Composition and Its Origin

HUBERT LYMAN CLARK

CARNEGIE INSTITUTION OF WASHINGTON PUBLICATION 566
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INTRODUCTION

It must not be assumed because of the amplitude of the title that the author considers our knowledge of the Australian echinoderm fauna as practically complete. Far from it! But that knowledge is now great enough to warrant assembling it in one volume and trying to make some deductions from it as to the origin and history of Australia's marine fauna. It is hoped, further, that these deductions may throw some light on the history of the Australian continent and its relation, if any, to Africa, Asia, and New Zealand. Owing to their relatively sedentary habits, their aversion to fresh or even brackish water, the brevity or complete absence of a free-swimming larval life, and the usually small bathymetrical range, echinoderms are remarkably suitable as material for studying changes in shore lines or the relation of land masses to each other.

A study of this kind was published by the Carnegie Institution of Washington some twenty-five years ago (H. L. Clark, 1921), dealing with the Torres Strait region and the origin of the echinoderm fauna of the Great Barrier Reef and the eastern coast of tropical Australia. The evidence is strong, if not strictly conclusive, that Torres Strait has not been the chief route by which the eastern coast of Australia has received its marine fauna, the greater part of that fauna having come from the northeast around the eastern end of New Guinea. So definite were the results of that study, it seemed worth while to extend it to the entire continent of Australia and see if light could thus be thrown on the history and possible "drift" of that land mass. Thanks to the generosity of the Carnegie Institution of Washington and the Milton Fund of Harvard University, with the hearty cooperation of the Museum of Comparative Zoölogy, two extended visits to Australia were made in 1929 and 1932. All parts of the continental coast were visited except the western half of the southern coast and the great northern Gulf of Carpentaria. In both these areas the local conditions are unfavorable to a diversified echinoderm fauna, so it is not likely that visits to those relatively inaccessible coasts would add very much that is significant to our knowledge of Australian echinoderms. (Exception may perhaps well be made of the southern coast of Western Australia, west of the Great Australian Bight, where indications of an interesting echinoderm fauna have been found.)

The two visits resulted in the collection of a very large amount of material, upon which a report has already been published (H. L. Clark, 1938). Aside

from the material obtained and the extensive observations made, the contacts with local "naturalists" and collectors were invaluable. The generous cooperation and assistance received from scientific colleagues, and particularly from the museums, have been encouraging and helpful beyond words. Whatever results have been achieved must be attributed in large part to this unselfish and magnanimous helpfulness. In both the 1921 and 1938 reports, the attempt has been made to express something of the debt owed to more than fifty individuals for their help. It is unnecessary to repeat those names here, but this introduction cannot be closed without expressing the author's lasting gratitude to the late Dr. C. Anderson, Director of the Australian Museum; the late Dr. John C. Merriam, President of the Carnegie Institution of Washington, 1920–1938; and particularly to the late Dr. Thomas Barbour, Director of the Museum of Comparative Zoölogy, without whose constant interest, encouragement, and support the work could never have been done.

In order to make use of all the available evidence, it has been deemed desirable to include in this report all the echinoderms known from Australia, regardless of whether they are living or extinct. To separate the various species by that arbitrary line is unnatural and unnecessary. The fossil echinoderms of Australia are therefore included herein in their natural positions in the system,[1] but groups or species which no longer have living representatives (so far as we know) are indicated by an asterisk (*). The report is divided into two parts. The first deals with the composition of the echinoderm fauna; the second discusses its relationships and possible origin. In the first, artificial keys are given to all the groups in the five classes of echinoderms known to occur in Australia, down to species. This part will therefore be of service, it is hoped, to all zoologists and paleontologists who wish to identify material with which they are working. The boundary of this geographical unit, Australia, is for practical reasons set at the 500-fathom line, except on the northern coast between longitude 128° and 145°, where it is arbitrarily set at 9° 30′ south latitude, so as to include the northern end of the Great Barrier Reef, but exclude New Guinea and the Arafura Sea. Sahul Bank and "Challenger" stations 188 and 189 are thus included in Australia, but 190 is not. Since Lord Howe Island is politically a part of New South Wales, and its echinoderms are essentially Australian, it is also, perhaps somewhat arbitrarily, included as part of Australia. *It must be emphasized that the keys are limited strictly to the species known up to January 1, 1941, from within the limits of the Australia thus artificially defined.* It is hoped that all such species both fossil and living are included. No illustrations are published herewith, as nearly all the species have been figured and references to such figures are given.

[1] Fossil species based on very imperfect material which defy any adequate specific diagnosis are omitted, but it is impossible to be consistent in this matter. I can only hope that none of my omissions will be considered unreasonable. The great help of the late Dr. Frederick Chapman, of Melbourne, in connection with the inclusion of the extinct echinoderms is herewith very gratefully acknowledged.

The second part of the report undertakes to analyze the composition of this Australian fauna, to ascertain its interrelations and probable point or points of origin, and, particularly, to compare it with the corresponding faunas (so far as they are known) of southern and eastern Africa, of India and adjoining seas, of the East Indian and western Pacific islands, and of New Zealand. As a result of such comparisons, it is hoped some light may be thrown on the plausibility of the Wegener hypothesis concerning the flotation of continents, as regards Australia. Conclusive evidence cannot be expected from the study of a single phylum of animals, but it may be hoped nevertheless that the usefulness of the hypothesis may be either increased or diminished by the results of this investigation.

PART I

ANNOTATED LIST OF THE ECHINODERMS OF AUSTRALIA, BOTH FOSSIL AND RECENT

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The echinoderm fauna of Australia is both large and diversified, including nearly 900 known species. There is every reason to believe that many more remain to be discovered, not only in the greater depths where little collecting has been done, but even in shallow water on the reefs and along shore where most of the known species have been found. Nevertheless, our knowledge has now reached a point where it is necessary to assemble and arrange it in a single volume, that it may be available to the zoologists and nature lovers of the oncoming generation. Fortunately, echinoderms are an exceptionally well defined and sharply limited group, and are moreover divisible into very clearly separated and easily distinguished classes. Seven of these classes are universally recognized, of which two have long been extinct and have no known representative in Australia. The other five occur abundantly on all parts of the Australian coast, where local conditions permit, and four of them are also of more or less general occurrence in fossiliferous rocks. These five classes are so sharply defined that a "key" by which to distinguish them is scarcely necessary. The Crinoidea (crinoids, sea lilies, or feather stars in popular phraseology) are at once recognizable by their feather-like arms and by the usual presence, at the center of the dorsal or aboral side, of a cluster of slender, segmented appendages (cirri) or, much more rarely, of a more or less elongated stalk, with or without cirri. The Asteroidea (sea stars) show great variety of size and form, but the arms are hollow, with parts of the digestive system enclosed; in extreme cases the arms are so short that they are not readily distinguishable from the body, the animal being more or less perfectly pentagonal or hexagonal. Cirri and feather-like arms are never present. The Ophiuroidea (ophiurans, brittle stars, or serpent stars) have solid, slender, more or less extensively segmented arms, which in some highly specialized groups are arborescent or fork dichotomously three or more times; in several genera (sometimes called sea spiders or basket fish) more than a dozen divisions of each arm may occur. The Echinoidea (echini, sea urchins, shield urchins, sand dollars, sand shillings, and heart urchins) are encased in a firm, usually rigid test, more or less covered with spines, and have no projecting arms. The test is commonly more or less hemispherical with the oral (lower) side flattened, but the form ranges from ellipsoidal (the vertical axis longer than the horizontal) to discoidal (the vertical axis only a small fraction of the horizontal). The spines are incredibly diversified in character, ranging from minute, well-nigh microscopic, short, slender ones to the heavy ones of the slate-pencil urchins, 100 mm. or more in length

and 10–12 mm. in diameter. The Holothurioidea (holothurians or sea cucumbers) are conspicuously unlike the other classes in that the skeleton is reduced, so that the body wall is (with a few notable exceptions) soft. Associated with this peculiarity is the elongation of the oral-aboral axis so that the animal lies on one side with the mouth at the anterior end of the body, the anus posterior. At first sight there is no indication of the radial symmetry so obvious in the other classes, but a cross section through the animal, midway between the mouth and anus, reveals a symmetry essentially the same as that of a regular sea urchin or a pentagonal sea star cut in a similar plane. The five classes, so sharply defined thus in their respective patterns of structure, show an equal and similar diversity in their movements, methods of feeding, and other habits. It is therefore most natural and feasible to treat each class by itself, and that course will here be followed.