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Monograph on the British Fossil Echinodermata from the Cretaceous Formations

Thomas Wright (1809–84) was a leading nineteenth-century monographer of the Mesozoic echinoderms ('spiny-skinned animals') of the British Isles. The task of describing the British Cretaceous echinoids (sea urchins) was originally to be undertaken by Edward Forbes (1815–54), but his untimely death thrust the responsibility onto Wright. This project was made the more difficult when the accumulated specimens of Forbes disappeared after his death. Fortunately, the British Cretaceous is particularly rich in echinoids, which have always been attractive to collectors, so many other sources were available for study. In particular, this work is dominated by the sea urchins of the Chalk, which are diverse, commonly well preserved and sometimes bizarre in morphology. Originally published in ten parts between 1864 and 1882, Wright's text is further enhanced by a suite of fine lithographic plates, mainly by Charles R. Bone (1808–75), who unfortunately died before completion of the project.

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THE CRETACEOUS ECHINOIDEA.

DIRECTIONS TO THE BINDER.

The Monograph on the Cretaceous Echinoidea will be found in the Volumes of the Palæontographical Society for the years 1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, and 1882.

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MONOGRAPH

ON THE

BRITISH FOSSIL

ECHINODERMATA

FROM

THE CRETACEOUS FORMATIONS.

BY

THOMAS WRIGHT, M.D., F.R.S., F.G.S.,

VICE-PRESIDENT OF THE PALÆONTOGRAPHICAL SOCIETY; CORRESPONDING MEMBER OF THE ROYAL SOCIETY OF SCIENCES OF LIÈGE; THE SOCIETY OF NATURAL SCIENCES OF NEUCHÂTEL; VICE-PRESIDENT OF THE COTTESWOLD NATURALISTS' FIELD CLUB; CONSULTING SURGEON TO THE CHELTENHAM HOSPITAL; AND MEDICAL OFFICER OF HEALTH TO THE URBAN SANITARY DISTRICTS OF CHELTENHAM, CHARLTON KINGS, AND LECKHAMPTON.

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PREFACE.

WITH this Preface the history of the British Fossil Cretaceous Echinoidea is brought to a close, and it only remains for the Author to record his warmest acknowledgments to the many kind friends, enumerated in the retrospect, who have generously assisted him in his long and laborious task. The duty imposed upon him by the Council of the Palæontographical Society, occasioned by the untimely death of his distinguished colleague, Prof. Edw. Forbes, F.R.S., has been much lightened by their ready, willing, and friendly aid at all times.

When the Plates for this Monograph had been nearly completed his accomplished artist, Mr. Charles Bone, who had assisted him during so many years, likewise passed away; so that in writing this preface the Author is solemnly reminded of the mutability of all human undertakings, and desires to express his deep regret that one who had aided him for nearly thirty years by steady, continuous, and most accurate work, had not been spared to see the conclusion of his labours. The Author, therefore, embraces the present opportunity of recording his high appreciation of Mr. Bone's artistic drawings, which for beauty and accuracy in lithographic art have not been surpassed, whilst all essential details relating to the anatomical structure of the Echinoidea have been faithfully rendered throughout.

The Author in an especial manner desires to return his warmest acknowledgment and very best thanks to his old friend the Rev. Professor Wiltshire, F.G.S., the indefatigable Secretary of the Palæontographical Society, for his unwearied attention to every part of his work as it passed in successive years through the press. The admirable summary of the British Cretaceous Echinoidea and copious index which he has kindly contributed to complete this volume, have added much to its value and general usefulness; and he must further add that the liberal

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supply of fine specimens from his rich collection of Chalk Echinoderms, in order to furnish the artist with the best possible specimens for the plates, has been of very great assistance in carrying out the work, and for which he now expresses his deep obligations, and records his lasting gratitude for all his most kind, generous, and friendly aid from first to last.

4, ST. MARGARET'S TERRACE, CHELTENHAM;
25th April, 1882.

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A RETROSPECT.

BEFORE bringing this Monograph to a termination I desire to state to my Readers (many of whom have joined our Society since the work was commenced), the circumstances under which I became the historian of the British Cretaceous Echinodermata, and the difficulties I experienced and had to overcome during the progress of its composition, as they help to explain the apparent delay that has occurred and the length of time which has elapsed between the issue of the first and last part of the Monograph.

When the History of the British Fossil Echinodermata was first proposed to the Council of the Palæontographical Society in 1851, by the late Professor Edward Forbes, it was arranged that the description of the Cretaceous species was to be undertaken by him, and that of the Jurassic species by myself. Long, however, before the Jurassic portion was complete my highly esteemed and learned colleague died (in November, 1854), very soon after he had attained the object of his life's ambition, the Chair of Natural History in the University of Edinburgh. Before leaving London, Professor Forbes had gathered from various sources a large collection of materials for the Cretaceous Monograph; these he took with him to Edinburgh, intending to commence the work as soon as he had settled down into the routine duties of his new chair; but his sudden death unfortunately deprived science of the rich store of facts and notes on the specimens he had collected from various cabinets for this work. Under these painful circumstances the Council of the Palæontographical Society urged me to undertake the description of the Cretaceous forms as soon as I had finished the Jurassic species; and this I consented to do in the belief that the materials collected by Professor Forbes would be available for the work. On making inquiry, however, I found to my dismay that after the death of my friend the fossils had been packed up with other property and sent into the cellars of the University, and could not be touched until some legal matters were arranged. A long delay now took place; and at last, when a search was made, the cases containing the Cretaceous specimens of Echinides could not be found. In this dilemma, and not then having a good collection of Chalk Urchins myself (all my energies up to that time having been given to complete my Jurassic collection), I applied to the authorities of the British Museum, to the Director of the Museum of Practical Geology (the late Sir Roderick Murchison); and to the Earl of Ducie, the Rev. Thos. Wiltshire, the late Dr. Bowerbank, the late Professor Tennant, the late Dr. S. Woodward, Mr. W. Cunnington,

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Major Cockburn, Mr. Caleb Evans, Mr. Robert Etheridge, and Mr. Weist. Messrs. E. T. Newton and Sharman, Assistant Naturalists of the Jermyn Street Museum, most kindly at all times aided me in making selections of specimens for figuring in the plates.

On the Continent I have had much friendly aid from MM. Gustave Cotteau, of Auxerre, Perceval de Loriol, of Geneva, Herr Struckmann, of Hanover, Professor De Koninck, of Liège, and the late MM. Seemann and Triger, of Paris.

In addition to the valuable aid of the above kind friends, to whom individually and collectively I tender my warmest thanks, I have made many tours of inspection to all the best private collections in England containing Chalk Echinoderms, and have visited and worked the quarries in the different Cretaceous formations, in order to identify the distribution of the species with the beds from whence they were said to have been collected. All these proceedings have occupied much time, and were undertaken at a period when I was fully occupied in the laborious practice of my profession, so that I found much difficulty in bringing out the parts consecutively in the annual volumes of the Palæontographical Society.

The many duties and incessant occupation connected with my present position as Medical Officer of Health having deprived me of the leisure necessary to continue my sketch of the History of Echinology, I ventured to ask my much esteemed friend, M. Perceval de Loriol (author of the 'Echinologie Helvetique'), to undertake this portion of the work. Monsieur de Loriol, with his usual kindness, consented to do so, I have, therefore, now the pleasure of introducing his masterly sketch (for the translation of which I alone am responsible) of the progress made in Echinology during the last twenty years. For this most valuable addition to my work I beg to return my highly accomplished friend my very warmest thanks.

"On the History of Echinology since 1862, by Perceval de Loriol.

The fourth part of the vast Monograph, undertaken by Dr. Wright, relating to the description of the Jurassic Echinides, was published in 1861. Dr. Wright had enriched that part with a Table, giving a list of the works concerning the Echinides, that had come to his knowledge up to that date. It will not be without interest and utility, therefore, to terminate the Monograph on the Cretaceous Echinides, to which Dr. Wright is now adding the last pages, with a rapid review of the progress which has been accomplished during the last twenty years in the domain of Echinology, and to take a glance at the magnificent discoveries for which we are indebted to the late Expeditions, which had for their object the investigations of the depths of the sea.

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Dr. Wright's numerous professional occupations not permitting him to enter upon this branch of the subject, he has asked me to take it upon myself, and it is with very great pleasure that I embrace the occasion of co-operating, in however feeble a degree, in a great and beautiful work, brought so happily to a conclusion by my learned friend.

Commencing with an enumeration of the many works written on the Fossil Echinides, I think we shall proceed with more method if they be grouped by countries and by regions, taking into consideration, not the nationality of the authors, but the Echinitic fauna upon which they have made their observations.[1]

The study of the Fossil Echinides of Great Britain appears during late years to be concentrated in the general Monograph by Dr. Wright, and I find myself able to cite only one paper, that by Mr. Keeping (1), 'On the Genus *Pelanechinus*, a new Section established for the *Hemipedina corallina*, Wright,' the coronal plates of which appear to have been in some measure imbricated, resembling those in *Asthenosoma*.

France has contributed a great number of works on Echinology, of which most are due to the indefatigable zeal and untiring industry of M. Gustave Cotteau, of Auxerre; and it is important to mention above all a work of the first order, the 'Echinides de la Paléontologie Française' (2), the publication of which is still being actively carried on.

The Échinides Crétacés,' commenced by d'Orbigny and continued by M. Cotteau, is now completed. Two volumes of the 'Échinides Jurassiques' have already appeared. They comprise the *Echinides irréguliers*, the family of the CIDARIDÆ, and those of the SALENIADÆ; those of the DIADEMATIDÆ will soon follow. Three other very important works of M. Cotteau, commenced many years ago, have been completed; the description of the Echinides of the Department of the Sarthe (3), in which he has made known the Urchins, so numerous and varied, which the Jurassic and Cretaceous strata of this Department contain, and the illustrations of which required sixty-five plates; the second part of the 'Echinides of the Yonne' (4), comprising the description and figures of ninety-nine species from the Terrains Crétacés; and lastly the first series of new or little known Echinides, which have successively appeared in the 'Revue et Magasin de Zoologie' (5), and in which are found valuable observations upon known species, as well as the description of numerous new species, the most part derived from France, but also from other countries. Independently of these works, as a whole, M. Cotteau has published many local Monographs, which have made great steps towards an exact know-

[1] To avoid the incumbrance of notes I shall add an appendix to this essay, in which I shall give the titles of the works to be identified by corresponding figures in the text. I have not cited all the works in which Fossil Echinides are mentioned, but only those which appear to me more specially important either as general works on the subject, or those in which some discovery is recorded. To this end I have made as conscientious an investigation of all the works as was in my power; but possibly some publications may have escaped my notice. If such should be the case I make an honorable amende in advance for the omission which I shall be the first to regret.

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ledge of the Echinitic Fauna of France. These contributions are in the form of notes, or lists of species, with observations made to clear up critical questions, with sometimes more complete studies on which the species are found entirely described and figured. M. Cotteau has thus made known successively the Nummulitic Echinides of Biarritz (6); the Cretaceous Urchins of Martigues (7); the Echinides of the Pyrenees (8); those of the Aube (9); and those of the Oxfordian of the Ardèche (10); new species from the Environs of Bordeaux (11); the Echinides of the Cretaceous Colony of the "Garonnien" of the Department of Aude (12), among which was found the first Cretaceous *Schizaster* known; those of the Miocene deposits of Corsica (13); those of the Jurassic strata of Normandy (14); and lastly, a supplementary note (15) completes the characteristics of the curious new genus *Tetracidaris*, from the Neocomian of Central France, which possesses two series of pairs of pores in each poriferous zone, and four series of inter-amubulacral plates. In addition to these beautiful monographic studies of M. Cotteau, there are other works upon the Echinides of France, which still remain to be enumerated. Thus, Saemann and Dollfuss, in 1861, characterised with care some species from Trouville (16). Dumortier, in his remarkable work upon the 'Depôts Jurassiques du Bassin du Rhône,' has described many Echinides from the Lias (17). M. Tournouer (18), has given a revision of the Echinides of the Calcaire à Astéries (Tongrian) of the South-west of France, with figures of new species and critical remarks on the same. Caffin (19) has occupied himself with the Echinides of the Environs of Evreux. M. Bucaille (20) has given a Catalogue Raissonné of those of the Seine Inférieure, with descriptions of new species. Professor Hébert (21) has endeavoured accurately to diagnose the characters of certain Hemiasters, and he has (22) described two new *Hemipneustes* from the Chalk of the Pyrenees. M. Sauvage (23) has made known new species from the Upper Jurassic of the Boulonnais. M. Arnaud (24) has endeavoured to facilitate the determination of the numerous Cretaceous species of the genus *Cyphosoma*, to which he has added some new forms. Desmoulins (25), to whom Echinology was already indebted for numerous works, has made some interesting observations upon six species of *Echinolampas*, upon the spines of *Echinocidaris*, and upon a Miocene *Spatangus* from Saucats. Finally, I have published (26) a description of some Echinides from Berrias and Aizy (27), and have been occupied with those from the Portlandian of the Yonne (28), also with those from the Upper Jurassic of the Boulonnais (29), and of the Haute Marne (30). A general work, by Dujardin and Hupè, upon the Echinoderms (31) has likewise to be mentioned.

In Switzerland the Echinologic studies, to which Agassiz and Desor had already given such vigorous impulsion, have been continued. Etallon (32), who had already studied the Echinides from different formations bordering on the frontiers of France (33 and 34) and of Switzerland, aided in the enlargement of a posthumous work of Thurmann's, 'Le Lethæa Bruntrutana' (35), in which numerous species of Echinides are found described and figured. M. Ooster (36) a few years afterwards published his

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'Synopsis of Fossil Echinoderms of the Swiss Alps,' in which numerous species from the Nummulitic formation are found figured. He has given also indications of certain Alpine species in his 'Protozoa Helvetica' (37). I have described also some Echinides from the Neocomian of Mont Salève (39), from the Valangian of Arzier (40), and the Urgonian of Landeron (41). I have also undertaken, under the title of 'Echinologie Helvetique' (42), the publication of the Fossil Urchins of Switzerland. In the First Part comprehending the Jurassic Echinides I had the happiness of having for my collaborator M. Desor. I afterwards finished alone the Second and Third Parts, which treat of the Cretaceous and Tertiary Echinides. Four hundred and thirty-eight species are the contingent of the Echinitic fauna furnished up to the present time by the Secondary and Tertiary formations of Switzerland.

Thanks to M. Cotteau, the Fossil Echinides of Belgium, hitherto known in a very summary manner, have been submitted to a new and very necessary revision. He has published, in succession, a 'Note on the Cretaceous Echinides of Hainaut' (43), with some species figured; the 'Description of the Echinides of the Calcaire Grossier' of Mons, Senonian (44); and the 'Description of the Tertiary Echinides of Belgium' (45), an important Monograph, in which thirty-one species are found figured and described, and of which thirteen species only were previously known, and the most of these very imperfectly.

It is likewise to M. Cotteau that we owe the knowledge of three interesting species from the Upper Chalk of Sweden (46).

Among the works which have appeared on the Echinides of Germany it behoves me to cite, in the first place, the volume on the History of Fossils of Germany,' which Professor Quenstedt has devoted to the Echinides (47). The Atlas of twenty-eight plates contains no less than 1700 figures, with numerous magnified views; whilst the text treats of not only the Echinides of Germany, but also many others which are not found there. This work, the result of very considerable labour, comprehends a great number of useful indications and previous observations; but it is to be regretted that Professor Quenstedt persists in his refusal to accept the nomenclature adopted in the mean time by all authors and corresponding to the actual state of our knowledge. The want of method and the improper denominations occasion much confusion, so that the practical utility of the work is much diminished. "Die Echiniden" has, nevertheless, a real value, and has advanced science principally in making known several details of the structure of many species which had not been previously observed, and in many cases it will be consulted with advantage. The Chalk of the North of Germany has furnished to M. Schlüter (48) many new species which he has described and figured. Subsequently he indicated some others, but only gave short diagnoses of them (49). Besides, many of the Cretaceous species from the same region have been well figured and described by Schlœnbach (50); and M. Dames has given a description of the Jurassic species collected in the North-west of Germany. The Echinides of the Upper Cretaceous strata of the Valley of the Elbe have been described and figured by Prof.

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Geinitz (52); and M. Schafhäutl has given figures of the Tertiary species from Kressenberg, but in general they have not been determined in a correct manner. It is important moreover to cite the new 'Handbuch der Palæontologie' by Prof. Zittel (54), and especially the well-written chapter treating of Echinoderms.

For the Empire of Austria I have equally many Echinologic works to mention. M. Cotteau (55) has made known the Echinides of Stramberg, derived from the strata about which so much controversy has taken place. M. Laube has decribed those from the Bathonian stage at Balin (56), and those from the Upper Tertiaries of Austro-Hungary; and he has discovered in the Eocene of the Mattsee (58) a new genus, the *Oolaster* bordering on *Ananchytes*. The Miocene strata of Ottnang have furnished to Herr R. Höerness (59) some species; and from those of the environs of Felmenes some others have been noted by Herr Loczy (60), amongst others a new and interesting *Echinocardium*.

The Urchins from the Eocene deposits of Hungary and Transylvania have been studied by Herr Pavay (61), who had undertaken a general Monograph on the Echinides of Hungary (62), of which his premature death only permitted him to give a first part to the world.

The Cretaceous strata, but especially the Tertiary beds, of Istria and of Friuli (64) have furnished many Echinides to M. Taramelli. His summary descriptions have been completed by M. Bittner (65), who has also enriched the Tertiary fauna of Istro-Dalmatia with new and interesting species.

The Tertiary strata of a region bordering upon Lombardy have been for a long time celebrated for their richness in Echinides, but a monographic study has not yet been made of them. Herr Schauroth (66), in his Catalogue of the Museum of Coburg, has made known in a very imperfect manner some new species. Herr Laube (67) has much augmented the number of forms, and grouping the whole of the known species, has endeavoured to establish a parallelism amongst the beds in which they are found. Herr Dames (68), following up these observations in a very extended memoir, has revised certain of Herr Laube's species, added new ones to the list, and established two new interesting groups:—the genus *Ilarionia*, which approaches *Pygorhynchus*, but possesses a pentagonal periostome; afterwards the curious genus *Oviclypeus*, which approaches very near to *Conoclypeus*, and like it, was provided with a masticatory apparatus. It behoves us still to cite a fossil species of the genus *Palæopneustes* recently discovered in the Seas of the Antilles. The Tertiary beds of the Vicentin seem to be almost inexhaustible, for Herr Bittner (65), following up the precited memoir with another, has been able to add many more species, among which he has discovered several new forms that were unknown to his predecessors.

The Miocene Mollusca of Italy have yielded to M. Manzoni (69, 70) many interesting Echinides; and in the Middle Miocene he has collected a large and curious species of *Spatangidæ* (71, 72). M. Gemellaro (73) has described some species from the Upper

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Sequanian of Sicily; and the Abbé Stoppani (74) has described some species from the Lower Lias of Lombardy.

Regarding the Echinides of Spain I have only a few remarks to make. There are two works by M. Cotteau, one very short, relative to some new Echinides collected in Spain by M. de Verneuil (75), and the other being a contribution to a memoir of M. Barrois upon the Cretaceous strata of the Province of Oviedo, giving a description of some new Echinides from the Urgonian (76).

The Echinitic fauna from the Miocene beds of the Island of Malta, which is very rich in fossil Urchins in a fine state of preservation, had been previously studied and reported upon by Dr. Wright (77). These fossils were subsequently the subject of a second memoir, in which are additional notes, and the description and figures of some new species. In the Island of Melos a very interesting little Echinitic fauna has been found, apparently of Pliocene age, and in which Herr Dames has discovered a *Cidaris*, very different from those which now live in the Mediterranean (78).

Before terminating my remarks relating to Europe I have still to mention a little work which I have made on the Tertiary and Cretaceous Echinides brought from the Crimea, by M. Ernest Favre (79).

Crossing now the Mediterranean to pass into Africa we arrive in Algeria, which appears to be the promised land to the Echinologist, for in almost all the geological formations of this region the Echinides abound in a surprising manner. M. Coquand (80), in his 'Palæontology of the Province of Constantine,' first made known a great number of species. Afterwards came the large and beautiful publication of MM. Cotteau, Péron, and Gauthier (81), which, commencing with the Jurassic strata, undertakes to describe all the Fossil Echinides of Algiers; this work has now reached the Senonian stage of the Cretaceous deposits. Among the numerous species which these rocks have yielded, the number of those appertaining to the genus *Hemiaster* is truly extraordinary. In a recent work by M. Coquand (82), a great number of additional species of the same genus are described, but unfortunately not figured, hence it is impossible to give an exact account of the value of their characters.

I am of opinion that a general revision of the species would result in diminishing the number, for I cannot but suspect that sufficient allowance has not been made for sexual differences, which are important, and which have been studied in *Hemiaster cavernosus* living in the Seas of Kerguelen, by Sir Wyville Thomson ('Challenger, Atlantic,' vol. ii, p. 229), and by Dr. Theoph. Studer ("Ueber Geschlechts Dimorphismus bei Echinodermen," 'Zool. Anzeiger,' Nos. 67 and 68, 1880). The beds in the North of Africa are certainly far from being exhausted, and the Tertiary strata yet unexplored doubtless contain many Echinides which by-and-by will become known. Mr. Etheridge has described a new Scutelloid genus obtained from the Miocene of Morocco (83), the genus *Rotuloidea*. The Tertiary deposits of Egypt contain numerous species of Echinides, of which some only have been described, and for the most part very imperfectly; they have

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been studied more completely of late years. Prof. Fraas has given an account of many Nummulitic species (84), and has discovered the large Clypeaster of the Pyramids (*Clypeaster Ægyptiacus*, Wright), from a Miocene rock. I have since published a 'Monograph of the Nummulitic Echinides of Egypt' (85), in which forty-four species are figured and described, and in another Monograph (86) the Eocene Echinides of Egypt and of Lybia, brought by Professor Zittel from his voyage of discovery with Dr. Rohlfs, the new species are added by me to that interesting Echinitic fauna. I may remark *en passant* that I have given in these monographs figures of the masticating apparatus of *Conoclypeus conoideus* which Dr. Zittel had already discovered. This genus ought, therefore, to be removed from the family of the CASSIDULIDÆ, in which it has hitherto been classed.

Our knowledge of the fossil Echinides of Asia is not yet very extensive. Since the 'Monograph on the Nummulitic Beds of India,' by MM. d'Archiac and J. Haime, the only extended memoir which has been published on the subject, to my knowledge at least, is that of M. Stolitzka (87), on the 'Echinoderms of the Cretaceous Formations of India,' in which thirty-eight species are figured and described. Some isolated documents may still be noticed. Prof. Duncan has enumerated eleven Cretaceous species collected in the South-east of Arabia, and at Bagh on the Nerbudda (88). He has likewise given indications of the Cretaceous Echinides of Sinai (89). M. Cotteau, in a notice on the Echinides collected in Syria by M. L. Lartet, has described some new species. Prof. Fraas (91), in his recent travels in Lebanon, has satisfactorily proved that the spines so long known under the name of *Cidaris glandifera*, and believed to be identical with those from the Sequanian stage are, on the contrary, distinct, and are found in Cenomanian beds. M. Fuchs, lastly, has made known some Echinides from the Miocene beds of Persia (92).

In the Island of Borneo Nummulitic beds are found containing Echinides, of which M. Fritsch has described some, establishing the genus *Verbeekia*, still very imperfectly characterised (93).

Thanks to Professor Zittel we know some Echinides from the Tertiary strata of New Zealand (94).

Many recent works, have had for their object the Echinides from the Tertiary strata of Australia; whence new species have been described by M. Laube (95), Mr. Etheridge (96), and Prof. Duncan (97), who has given a list of the species from the Tertiary strata of Australia actually known. They are to the number of twenty-four, and embrace two new genera, *Paradoxechinus*, Laube, and *Megalaster*, Duncan.

It now remains for us to cross the Pacific to California, where we shall have to remark upon some very curious Miocene and Pliocene species of Echinides, discovered by Mr. Remond (98), and figured anew by Dr. Gabb (99). Some new species are still to be indicated from the Eocene of South Carolina, by M. Conrad. Beyond this I have only been able to discover a few isolated notices upon the Secondary and Tertiary

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Echinides of the United States in the works published during the last twenty years. On the other hand, assisted by the activity of my learned friend M. Cotteau, whose name I have had to mention in connection with the Echinitic faunas of almost every region, the fossil Echinides of the Antilles are now very well known. Mr. Guppy had already published nine new species from the Tertiary formations of the Island of Anguilla. M. Cotteau (102) has added as many as twenty-six Eocene and Miocene forms. He has made known the magnificent species of the genus *Asterostoma* (103), of which we had known only up to the present the single individual type, coming from the Tertiary strata of the Island of Cuba, where it is accompanied with some other species, which will be figured afterwards.

In South America the Echinitic works within my knowledge are the isolated descriptions of some new species. Philippi (104) has described some from Bolivia; Herr Steinmann (105) has just added two others; and I have described one from Ecuador (106).

To this rapid exposé of the progress of our knowledge of the fossil Echinides during the last twenty years, it will not be out of place to add a few words on the recent discoveries which have been made among living Echinides in the existing seas. It does not, however, appear necessary to enter into much detail or to do more than mention the published works. The magnificent and excellent work of Alexander Agassiz (107), 'Revision of the Echini,' published between 1872 and 1874, faithfully resumes all the works anterior to it, and, so to speak, fixes our ideas upon the species of Echinides known up to this time in our seas. It will always serve as a *point de depart* for all future works. The number of distinct species which are there found established and described amounts to 206. Since then the number has been considerably augmented, but always and almost solely by the recent Expeditions undertaken for the exploration of the bed of the sea, aided by dredges and appropriate machinery placed at the command of the explorers. Most of the new types which have been discovered belong to the most extraordinary forms; and some of these represent genera found hitherto only in a fossil state, connecting in a very remarkable manner the existing fauna with that of former times. Already in the Dredging Expedition of the "Porcupine," Wyville Thomson had observed in the living state and made known in a complete manner the *Asthenosoma* (109), those regular Urchins so curious with a flexible test composed of imbricated plates, reminding us of certain Palæozoic genera and belonging to a family, the ECHINOTHURIDÆ, represented up to the present time by some fragments found in the Upper Chalk and a single example of a recent species from an uncertain province. We know actually that it was one of two species all living in depths from 10 to 2,750 fathoms, but principally in the greatest depths. The appearance of the first species of *Pourtalesia*, dredged by François de Pourtales in the latitude of the Antilles, had astonished all the Echinologists. This extraordinary genus, bordering on the *Holaster* and almost on the *Infulaster*, approached more particularly the Urchins of the

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White Chalk. We have lately discovered that there are several species, most of them bizarres forms; and the Expedition of the "Challenger" has made known many new genera, which are connected with it, so that now this species, known at first by a single example, has become the *point de depart*, a few years after its discovery, of a family which appears to be truly limited to great depths. These two examples will suffice perhaps to make us appreciate the development of our knowledge of the Echinides of the actual seas during the last eight years.

I do not intend to enlarge here upon the new species and the new genera which have been successively brought to light by the dredging expeditions of the "Porcupine," of the "Hasler" (110), of the "Josephine," of the "Blake" (111), of the "Challenger" (112). This last, which perhaps may be considered the most fruitful, has brought to our knowledge no less than forty-four new species and sixteen new genera. We are able to estimate roundly at 300 the number of the species which we know in our actual seas, and it is not only the discovery of new types which we owe to these expeditions, so rich in results of all kinds, but numerous and valuable indications and information on the geographical distribution of species, and on their vast bathymetrical limits, which are of the greatest utility in explaining certain facts relative to the distribution of fossil species, a subject upon which, perhaps, we may have experienced embarrassment. Now that we know that the *Spatangus Rashi* is found from the Hebrides to the Cape of Good Hope, that the *Brissopsis lyrifera* and the *Schizaster fragilis* are met with both in the seas of Norway and in the south of the Indian Ocean, and that certain species of *Cidaris* descend from the shore to 2000 fathoms, and that a *Phormosoma* descends from 200 to 2700 fathoms, many facts relating to fossil Echinides will perhaps be able to find an interpretation.

This is not the place to recapitulate the progress of the state of our knowledge upon the Morphology, the Anatomy, and the Embryogeny of the Echinides; moreover, I am not competent to undertake the work.

I desire only to mention a remarkable work by M. Lovén (113), 'Études sur les Échinides,' accompanied by fifty-three excellent plates which contain very curious and most interesting researches on the structure of the solid skeleton of Urchins, and on the different points in their organisation. This useful work ought to be studied by all those who wish to make the Echinides the object of serious research.

My task is now brought to a termination. I hope that those who, in the next twenty years, undertake a similar work will be able to register as many new facts, as many new discoveries, and as much progress of all kinds in the study of this very interesting group of animals, of which I have endeavoured to give a *résumé* in the following summary Table, which is probably less complete than I wished it to be.

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