On the Sponge-remains in the Lower Tertiary Strata near Oamaru, Otago, New Zealand. By G. Jennings Hinde, Ph.D., and W. Murton Holmes. (Communicated by W. Percy Sladen, Sec. Linn. Soc.)

[Read 4th February, 1891.]

(Plates VII.–XV.)

Introduction.

The Sponge-remains described in this paper were obtained from beds of siliceous or siliceo-calcareous material of some considerable thickness, which are exposed in several localities in the vicinity of the town of Oamaru, on the east coast of the South Island of New Zealand. Specimens of this material were first sent to this country, in the early part of 1886, by Capt. F. W. Hutton, F.G.S., Professor of Geology at Christchurch, New Zealand, who described it in a letter to Prof. Rupert Jones, F.R.S., as a Radiolarian ooze containing large quantities of sponge-spicules and radiolarians. Subsequently other examples of the rock were brought over by the late Sir J. v. Haast and exhibited at the Colonial Exhibition at South Kensington, and fragments of it were freely distributed to those interested in microscopic research. On examination, the rock proved to be extraordinarily rich not only in the organisms referred to by Capt. Hutton, but in diatoms as well, and these last-named forms have since been carefully worked out and described by Messrs. Grove and Sturt in the Journal of the Quekett Microscopical Club *. These authors have enumerated 283 different forms, 107 of which are new species or varieties. From the great abundance and variety of these organisms, the beds have been regarded as a diatomaceous deposit, but it is evident that the rock contains such a commixture of sponge-remains, radiolarians, and diatoms, that it can just as appropriately be designated after one of these forms of life as after another.

From information supplied by Capt. Hutton, and from an account of the deposit given by Mr. H. A. de Lautour in the Transactions of the New Zealand Institute †, it appears that the principal exposures of this siliceous rock are Cormack's siding in

* Ser. 2, vols. ii. & iii., 1886–87.

† Vol. xxi. 1888, pp. 293–311, pls. xviii.–xxiii.

Cave Valley, and Jackson's paddock and Bain's farm in the adjoining Waiarekei Valley, about four miles from Oamaru. At Jackson's paddock the beds have a thickness of from 40 to 60 feet. They are immediately overlain by the well-known Ototara limestone, and they rest on beds of volcanic rock. In some places also the deposit is traversed by volcanic dykes, which have had the effect of hardening and partially fusing the siliceous material in their vicinity. There is some difference of opinion amongst New Zealand geologists as to the relative age of this Ototara limestone and the siliceous beds beneath it. By Sir Jas. Hector, F.R.S. *, they are considered to be of Cretaceo-Tertiary age, about the horizon of the Lower Eocene; Capt. Hutton †, on the other hand, places them in the Upper Eocene or Oligocene, and this latter view is probably approximately correct.

In general appearance the specimens of this Oamaru material which have been sent to this country very much resemble our Upper White Chalk; they are, when dry, of a greyish-white tint, soft, earthy, friable, and readily breaking up into a fine mud of a creamy tint in water. Unlike the chalk, however, most of the specimens appear to be entirely siliceous, and show no reaction with acid, but in some there is a small proportion of calcareous material. In the rock unaltered by heat, the different kinds of microscopic organisms of which it is composed are heterogeneously intermingled together, and the individual forms are either entirely free from each other, or lightly cemented by an impalpably fine material formed mainly by the comminuted skeletal débris of the diatoms and radiolarians, so that by careful manipulation these organisms may be obtained free from matrix. The deposit seems to be nearly wholly of organic origin; no sand or other coarse materials of mechanical derivation can be distinguished in it. The distribution of the different kinds of organisms is by no means uniform throughout the deposit, for while some specimens consist chiefly of diatoms with a few radiolaria and the minuter forms of sponge-spicules, in others the spicules are relatively large and there is only a slight admixture of diatoms. It has also been noticed that certain genera of diatoms are abundant in some portions of the rock and very rare in others. In the partially calcareous portions, foraminifera are also present, and it is evident

* Report 1876–7 Geological Survey of New Zealand, pp. iv, 48.

† Geology of Otago, 1875, p. 54.

that the small quantity of carbonate of lime occasionally occurring in the rock is due to the tests of these organisms.

The general character and composition of this Oamaru siliceous rock show a close resemblance to those pelagic deep-sea deposits discovered by the 'Challenger' Expedition, which have been described under the names of Diatom and Radiolarian oozes. As in these oozes, the Oamaru rock is largely made up of minute organisms in varying proportions; sometimes the diatoms preponderate, in others radiolarians are abundant, whilst throughout there is so considerable an admixture of sponge-spicules that the rock might fairly be termed a sponge-bed. In the recent oozes sponge-spicules also appear to be generally present; there is further, in the majority of these deep-sea deposits, a small number of foraminifera, and these organisms are also present, but not in any great proportion, in some specimens of the Oamaru rock, whilst in others there are no traces of them and the rock is wholly siliceous. The absence of coarse arenaceous materials is the same in the Oamaru as in the recent deep-sea ooze. We may therefore conclude that this Oamaru rock was a deep-sea deposit, formed at some considerable distance from land, and that it may rightly be compared with the Diatom ooze which now forms a belt of varying width surrounding the South Polar Regions, and extending from the Antarctic Circle to about lat. 40° S. This recent Diatom ooze has a range in depth of from 600 fathoms to 1975 fathoms, with an average, according to the 'Challenger' Report* lately issued, of 1477 fathoms. The large proportion of radiolaria in some of the Oamaru specimens may even indicate a greater depth than that of a more distinct Diatom ooze; and this supposition is to a certain extent confirmed by the character of some ooze dredged up by H.M.S. 'Egeria' from depths of 2479 and 3000 fathoms in lat. 36° 53′ S., long. 115° E., and lat. 36° 08′ S., long. 117° 10′ E., respectively. This area is off the south-west coast of Australia. In this ooze there are numerous detached sponge-spicules with radiolaria, and many of the former are closely allied to those from Oamaru.

There is a very great contrast between this siliceous Oamaru deposit and that which, according to the 'Challenger' Report, is now forming off the east coasts of New Zealand at depths of from 700 to 1100 fathoms. This recent deposit is a blue mud

* Deep-Sea Deposits.

with from 4 to 10 per cent. of carbonate of lime, and it consists chiefly of amorphous and clayey matter and fine mineral particles from the neighbouring land, whilst there are very few siliceous organisms in it.

The only *fossil* deposit which nearly resembles in character the Oamaru rock is the so-called Radiolarian rock of Barbados. In this, however, the radiolaria preponderate, but diatoms also are abundant and many of the forms are, according to Messrs. Grove and Sturt, identical with those in Oamaru. Some characteristic sponge-spicules are also common to these widely-separated deposits, but, so far as we are aware, the sponge-remains in the Barbados rock have as yet not been systematically studied.

Mineral and other conditions of the Sponge-remains.

As a rule, in the rock unaltered by heat, but little chemical change appears to have taken place in the siliceous skeletons of which it is composed. The sponge-spicules, radiolaria, and diatoms retain, for the most part, the same smooth, brilliant, glassy appearance as in existing forms. In a few instances, however, this clear glassy aspect is replaced by a dull milk-white tint, and the spicules thus changed are precisely similar in structure to the least-altered fossil forms occurring in the Upper Greensand Sponge-beds at Warminster, Wiltshire *, and in the Westphalian beds of the age of the Upper Chalk described by v. Zittel †. Occasionally also spicules are met with traversed throughout by minute curved cracks or lines like those already ‡ described in certain of the Upper Greensand beds of this country. But in both the glassy and milk-white conditions the silica of the spicules retains the colloid or opalized state, and no instance has been observed in which it has passed into the form of chalcedony, as is generally the case with fossil spicules from the Cretaceous and older rocks. The few instances in which change from the glassy to the milk-white state has taken place tend to show that the unusually perfect condition of preservation is due to the more recent age of the beds and to specially favourable circumstances of fossilization. It may be said that, as a whole, the condition of these Oamaru spicules differs hardly at all from that of the detached spicules brought up by the dredge

* Phil. Trans. vol. clxxv. pt. ii. 1885, p. 426.

† "Ueber Cœloptychium," Bay. Akad. d. Wiss. B . xii. Abth. iii. p. 29.

‡ Phil. Trans. *l. c.* p. 426, pl. 40. figs. 8, 9.

from the present sea-bottom. Even in these recent spicules there is often an enlargement of the axial canals due to a partial solution of the spicular walls, and similarly enlarged canals are likewise shown in these fossil forms. Not infrequently the enlarged canals in the fossil forms have been infilled with a greenish mineral which now appears as a slender axial rod distinct from the spicular wall, and in some cases this rod has subsequently been contracted and contorted within the spicule so as to resemble a foreign vermiform body. In many instances also the Oamaru spicules have suffered from the peculiar borings in their walls so common in spicules from the deep-sea deposits *.

Not only have these Oamaru sponge-spicules retained their original structure of opalized silica, but their forms have to a great extent been preserved intact, with their surface adornment of spines, &c., to the minutest microscopic detail. They have naturally suffered less from mechanical pressure than the more delicate diatoms and radiolaria whose broken up fragments mainly form the finer portions of the rock.

In describing the sponge-remains in this deposit we are necessarily limited to the characters shown by the detached spicular elements of these organisms, which are now indiscriminately mingled together in the rock. Notwithstanding the great abundance of these detached spicules, and the fact that they belong to a great variety of sponges, no entire specimen of a fossil sponge, nor even a connected fragment, appears as yet to have been discovered in these beds. It is fairly certain that the sponges lived and died at considerable ocean depths, and thus were not likely to be exposed to any great disturbing influences from currents; and yet their skeletons seem to have been thoroughly disintegrated, so that it is rare to find even two or three of their spicules still in their natural association with respect to each other. Not only is this the case with monactinellid and tetractinellid sponges, whose spicules are merely held in position by the soft animal structures, but it is equally true with the spicules of lithistid sponges, and still more strange with the connected meshwork of hexactinellids, which occurs broken up into microscopic fragments. There is consequently no clue to the form or canal-structure of the sponges to which these spicules belonged, and the only comparison available is that of the relative similarity of the individual spicules with those of

* See Duncan, Journ. R. Micr. Soc. ser. 2, vol. i. (1881), p. 557, pls. vii., viii.

other fossil and existing sponges. But as recent sponges are mainly classified according to the characters of their spicules, we are able, from the study of these fossil forms, to gain a knowledge of the genera and species of these organisms represented in this rock. The excellent state of preservation of the spicules in this material is a great advantage for their study, and still more important is the fact that very many of the minuter forms or so-called flesh-spicules have been preserved. These latter are of very rare occurrence in the fossil state, and their number and variety of form in this deposit exceed by far what has hitherto been recorded.

A comparison of these Tertiary New Zealand spicules with those of recent sponges described by Carter, Oscar Schmidt, Bowerbank, and other spongologists, and more especially with those figured in the 'Challenger' Reports on these organisms, shows on the whole a remarkable similarity between them; the differences are mainly in details of size and form, such as would indicate specific rather than generic or family variation. A striking feature in the Oamaru deposit is the extraordinary commingling of representatives of different divisions of sponges to an extent greater than has been proved to exist in other similar fossil deposits.

To a great extent our comparison of the fossil with recent spicules has been necessarily limited to those of known sponges, for no attempt has been made to study or describe the *detached* spicules which are so numerous in recent deep-sea deposits, and from what we have seen of those obtained by the 'Egeria' it is certain that many belong to sponges which are as yet unknown to science.

Many of the forms in the Oamaru deposit have their nearest existing allies living in the Indian Ocean and in the Australian Seas, but the relations of some others are now only known from areas widely separate from New Zealand: thus, for example, the genus *Guitarra*, Carter, fairly well represented at Oamaru (Pl. XI. figs. 1–7), has hitherto only been known from the Gulf of Mexico and the North Atlantic.

Though it is probable that most of the spicules referred to later on belong to species not hitherto described, it has not seemed desirable to apply trivial names to them except in a few instances where the forms are very markedly different from those of species already known. We propose to treat these spicules under the groups of the Monactinellidæ, Zittel (or Monaxonida, Ridley & Dendy), Tetractinellidæ, Marshall, Lithistidæ, Osc. Schmidt, and Hexactinellidæ, Osc. Schmidt.

I. MONACTINELLIDÆ, *Zittel* (=Monaxonida, *Ridley & Dendy*).

In this division, which appears to have been more numerously represented than any other, the characteristic acerate, cylindrical, acuate, and pin-shaped skeletal spicules are very abundant and exhibit numerous gradations of size, and there is a considerable variety of the anchorate, hook-shaped, and sceptre-like flesh-spicules. The skeletal spicules of this group are as a rule such simple forms and common to so many genera as to be of little service in classification, but the minuter flesh-spicules, many of which are so small as to require to be figured on the scale of 600 diameters, afford good generic and specific indications. Hitherto so little has been known of fossil sponges of this group, that it has been supposed that they did not exist in any numbers in earlier epochs; but the evidence from this deposit shows that in the New Zealand region they abundantly flourished during the Early Tertiary period, and that they were proportionately as numerous and as varied as at the present day.

Skeletal Spicules of Reniera, Chalina, *and allied Genera.*

Pl. VII. figs. 1, 2. Smooth acerates, slightly curved, slender, ranging from ·106 to ·15 mm. in length by ·005 to ·009 mm. in thickness.

Pl. VII. figs. 3–8. Smooth acerates, curved, fusiform, stouter than the preceding, varying between ·145 and ·37 mm. in length by ·013–·03 mm. in maximum thickness. Spicules of similar forms and proportions to these are very generally present in existing species of *Reniera* and *Chalina*.

Pl. VII. figs. 9, 10. Smooth, slender acerates, fusiform, very elongate, straight or sinuous, one end sometimes tapering more rapidly than the other. Length ·9–1·14 mm. by ·015–·02 mm. in thickness. Similar spicules are figured by Ridley and Dendy in *Halichondria latrunculioides* (Chall. Rep. vol. xx. p. 6, pl. ii. fig. 1), from off the Rio de la Plata at a depth of 600 fathoms.

Pl. VII. figs. 11–13. Acerate spicules with nearly straight, smooth, cylindrical shafts and abruptly-pointed extremities.

Length ·12–·3 mm. by ·013–·024 mm. in thickness. Spicules similar to fig. 13 but less robust occur in *Cladochalina nuda*, var. *abruptispicula*, Ridley (' Alert ' Rep. (1884) p. 396, pl. xli. fig. *j*), from Torres Straits.

Pl. VII. figs. 31–36. Cylindrical spicules, smooth, evenly curved, with rounded non-inflated ends. They are of very varying length, the smaller forms so reduced as to become reniform (fig. 32). The axial canals but seldom shown. Length from ·025 to ·195 mm. by ·014–·03 mm. in thickness. Spicules of this type are common as fossils from the Carboniferous formation upwards, but the older forms are generally much larger than the Tertiary and Recent. A recent sponge with similar spicules from the Gulf of Manaar is referred by Carter to *Reniera* (Ann. & Mag. N. H. s. 5, vol. vi. p. 48, pl. v. fig. 18).

Pl. VII. fig. 46. Cylindrical, smooth, nearly straight, ends evenly rounded, to a slight degree thicker near the ends than in the central portion of the spicule. Length ·37 mm. by ·02 mm. in thickness. Spicules of this type are present in *Reniera*, *Myxilla*, and other genera. The spicules of the existing *Reniera cratera*, Osc. Sch. (Spong. Adriat. p. 73, pl. vii. fig. 7), are closely similar.

Pl. VII. figs. 45, 47. Cylindrical, smooth, elongate, slightly curved, ends obtuse or rounded. Length ·26 to ·37 mm. by ·005 to ·006 mm. in thickness. Similar but slightly larger spicules are present in *Raspailia tenuis*, Ridley & Dendy (Chall. Rep. vol. xx. p. 188, pl. xl. fig. 8 *b*), from near Bahia in shallow water, and they occur detached in dredgings from off the S.W. coast of Australia, at a depth of 2479 fathoms.

Pl. VII. figs. 23–25. Smooth, fusiform, acerate spicules, straight or slightly curved, with a well-marked central bulbous inflation. The axial canal is continuous throughout the spicule, with a very slight central inflation. Length from ·1 to ·32 mm. by ·013–·03 mm. in thickness. Similar spicules are figured by Bowerbank in *Isodictya anomala* (Mon. Brit. Spong. iii. pl. l. fig. 3) and by Carter in *Halichondria aceratospiculum* (Ann. & Mag. N. H. s. 5, vol. vi. pl. v. fig. 19 *b*); also by Hansen in *Cladorhiza abyssicola*, Sars (Norw. North-Atl. Exp., Spong. pl. iv. fig. 4).

Spined Skeletal Spicules of various Genera.

Pl. VII. fig. 15. Fusiform, curved, very gradually tapering, thickly spined throughout ; spines small, without arrangement. Axial canal opening at both ends. Similarly spined but smaller spicules occur in *Halichondria infrequens*, Carter (Ann. & Mag. N. H. s. 5, vol. vii. 1881, p. 369, pl. xviii. fig. 9 *a*), from the Gulf of Manaar.

Pl. VII. fig. 16. Acerate, fusiform, nearly straight, gradually tapering to acutely pointed extremities. Surface with strong stout spines projecting at right angles, irregularly distributed. Length ·076 mm. by ·014 mm. in thickness, including the spines. Similar spicules are present in *Sclerilla dura*, Hansen (Norw. North-Atl. Exp., Spong. pl. ii. fig. 5).

Pl. VII. fig. 17. Acerate, fusiform, slightly arcuate, ends abrupt and very acute. Spines disposed verticillately, the largest in the central portion are directed outwards, those near the ends are slightly recurved. Length ·14 mm., thickness ·025 mm.

Pl. VII. fig. 18. Acerate, fusiform, a slight inflation in the centre, from which the straight rays diverge at an open angle. A continuous axial canal. Spines very small, sparsely and irregularly distributed. Length ·14 mm., thickness ·015 mm. Rare. Spicules similar in form but without spines occur in *Halichondria aceratospiculum*, Carter, from the Gulf of Manaar (Ann. & Mag. N. H. s. 5, vol. vi. 1880, p. 49, pl. v. fig. 19 *b*).

Pl. VII. figs. 19, 22. Acerate, fusiform, with a strongly-marked bend in centre, acutely pointed. Spines numerous, small, blunted, irregularly distributed, projecting at right angles. Length ·175 mm., thickness ·015 mm. Similar but slightly smaller spicules are present in the dermal membrane of *Hymedesmia inflata*, Bow. (Mon. Brit. Spong. vol. iii. p. 248, pl. 79. fig. 8), from Shetland.

Pl. VII. fig. 20. Curved acerate, nearly cylindrical throughout its length, with abruptly pointed ends. Surface thickly covered with small irregularly distributed spines, which are more numerous near the centre than at the ends of the spicule. Length ·2 mm., thickness ·011 mm.

Pl. VII. fig. 21. Slender, fusiform, slightly contort, gradually tapering to acute points; surface annulated with smooth rings, those near the ends minutely tuberculate. Length ·255 mm., thickness ·01 mm. Mr. Carter figures similarly annulated spicules in *Hymerhaphia eruca* (Ann. & Mag. N. H. s. 5, vol. vi. p. 46, pl. iv. fig. 9 *b*), from the Gulf of Manaar.

Pl. VII. fig. 41. Acerate spicule with straight subcylindrical or subfusiform shaft and obtusely conical extremities. The shaft has irregularly scattered stout spines—those in the centre projecting directly outwards; near the ends the spines are smaller and oblique in direction. Length ·21 mm., thickness (including spines) ·04 mm.

Pl. VII. fig. 27. Subcylindrical spicule, irregularly curved, ends obtusely rounded; surface with small spines irregularly distributed but more numerous near the ends. Length ·17 mm., thickness ·024 mm. Rare.

Pl. VII. fig. 28. Spicule subcylindrical, bent so that the rays form a slight angle at the centre, ends blunted and spined. Surface verticillately spined; the spines short, conical, projecting directly outwards. Axial canal with a distinct central bend, closed at both ends of the spicule. Length ·21 mm., thickness ·022 mm.

Pl. VII. fig. 29. Subcylindrical spicule, slightly curved and somewhat thicker in the central portion, ends evenly rounded and spined, surface verticillately spined; the verticils closer near the ends, spines minute. Length ·23 mm., thickness ·015 mm.

Pl. VII. fig. 30. Cylindrical, slightly curved spicules with evenly rounded ends; spines short, blunted, disposed in verticils at about equal distances apart; ends thickly spined. Length ·135 mm., thickness ·013 mm. Mr. Carter has figured a similar spicule from an unknown sponge from the Gulf of Manaar (Ann. & Mag. N. H. s. 5, vol. vi. 1880, pl. v. fig. 29).

Pl. VII. fig. 40. Cylindrical, evenly curved, ends evenly rounded and very thickly spined; spines irregularly distributed. Length ·085 mm., thickness ·012 mm.

Pl. VII. fig. 38. Spicule subcylindrical, slightly inflated in the centre, ends obtusely rounded; surface with spiral ridges or crests of minute tubercles or spines, the ends likewise spined. Length ·16 mm., thickness ·02 mm. Similar spicules have been figured by Mr. Carter in *Dotona pulchella*, from the Gulf of Manaar (Ann. & Mag. N. H. s. 5, vol. vi. p. 57, pl. v. fig. 24).

Dumb-bell Skeletal Spicules of Plocamia, *Osc. Schmidt.*

Pl. VII. fig. 37. Cylindrical, slightly curved, with inflated ends. The shaft is quite smooth, whilst the ends are very minutely spined or tuberculate. Length ·095 mm., thickness ·015 mm. This spicule resembles those in *Plocamia* (*Dictyocylindrus*) *manaarensis*, Carter, sp. (Ann. & Mag. N. H. s. 5, vol. vi. 1880, p. 37, pl. iv. fig. 1 *c*), but it is not more than half the length. See also Ridley (Journ. Linn. Soc., Zool. vol. xv. 1881, p. 482).

Pl. VII. fig. 39. Cylindrical, curved, ends slightly inflated. The entire surface thickly set with small spines. Length ·125 mm., thickness ·014 mm.

Pl. VII. fig. 51. Cylindrical, with straight shaft and curved ends. The straight portion has stout conical spines projecting directly outwards, whilst the ends are evenly rounded and smooth. Length ·16 mm., thickness ·02 mm.

Spicules of Alectona, *Carter.*

Pl. VII. fig. 44. Acerate spicule, bent in the middle, slowly tapering to the ends, which are obtuse and spined. Surface with numerous stout spines which have an apparent linear arrangement. The axial canal extends throughout the spicule and opens at the ends. Length ·35 mm., thickness ·035 mm. This form has the same general characters as the large spicules of *Alectona Millari*, Carter (Journ. R. Micros. Soc. vol. ii. 1879, p. 494, pl. xvii. fig. 3), from the North Atlantic at a depth of 363 fathoms. Detached spicules of the same form but with larger nodes are present in dredgings from off the S.W. coast of Australia at a depth of 2479 fathoms.

Pl. VII. fig. 26. Fusiform acerate, evenly tapering to both ends; in the central portion of the spicule a few scattered spines. Length ·077 mm., thickness ·01 mm. This form may be compared with the subskeletal flesh-spicules of *Alectona Millari*, Carter (l. c. pl. xvii. fig. 4).

Skeletal Spicules of Hymeniacidon (?), *Bow.*

Pl. VII. figs. 42, 43. Subcylindrical spicules with obtuse ends, armed throughout with stout, short, conical, acutely pointed spines, without definite arrangement. Length ·17 mm., thickness from ·05 to ·08 mm. Spicules of the same character but smaller have been figured by Bowerbank in *Hymeniacidon Cliftoni* (Mon. Brit. Spong. vol. i. pp. 233, 276, pl. i. fig. 33, pl. xvii. fig. 291), from Freemantle, Western Australia.

Skeletal Spicules of Axinella, *Osc. Schmidt.*

Pl. VII. fig. 52. Spicules subcylindrical, vermicular, smooth, with obtusely rounded ends. Length ·29 mm., thickness ·015 mm. Similar spicules are figured by Ridley and Dendy in *Axinella erecta*, Carter, sp. (Chall. Rep. vol. xx. p. 182, pl. xl. fig. 1 *a*), from off Crozet Island, at depths between 550 and 1600 fathoms, and according to Mr. Carter this species is likewise plentiful in the Gulf of Manaar (Ann. & Mag. N. H. s. 5, vol. vi. 1880, p. 46) and also at various depths in the Atlantic.

Tibiella Spicules of Myxilla, *O. Schmidt, and other Genera.*

Pl. VII. fig. 14. Slender, regularly curved, fusiform spicule, gradually tapering to either end and terminating with a conical or lance-shaped inflation. Length ·45 mm., thickness ·01 mm. Spicules of a similar character but slightly larger are present in *Histoderma appendiculatum*, Carter (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 220, pl. xv. fig. 39 *b*), from the depths of the Atlantic.

Pl. VII. fig. 48. Tibiella stout, curved, fusiform, tapering gradually to each end and with inflated ovoidal extremities. Length ·61 mm., thickness ·032 mm. This is both larger and stouter than the preceding, and the inflated ends likewise differ.

Pl. VII. fig. 49. Tibiella subfusiform, curved, with evenly rounded club-shaped terminations, not constricted near the ends. Length ·37 mm., thickness ·012 mm.

Pl. VII. fig. 50. Stout, slightly curved, fusiform tibiella, with ovoid terminal expansions. Slightly constricted near the ends. Length ·72 mm., thickness ·06 mm.

Pl. VIII. fig. 1. Tibiella with smooth, nearly evenly cylindrical, curved shaft and elongate club-shaped terminations. Length ·412 mm., thickness ·017 mm.

Pl. VIII. fig. 2. Slender, smooth, slightly undulating cylindrical shaft with clavate terminations. Length ·365 mm., thickness ·006 mm. Spicules similar in form but slightly larger are present in *Forcepia colonensis*, Carter (Ann. & Mag. N. H. s. 5, vol. xv. 1885, p. 110, pl. iv. fig. 2 *a*), from off Port Phillip Heads, Australia, at a depth of 19 fathoms.

Pl. VIII. fig. 3. Tibiella with elongate, cylindrical, irregularly curved shaft and prominent club-shaped ends. Length ·765 mm., thickness ·008 mm. Slightly shorter, but otherwise similar spicules occur in *Phlœodictyon birotuliferum*, Carter (Ann. & Mag. N. H. s. 5, vol. xviii. p. 447, pl. x. fig. 2 *b*), from off Western Australia.

Pl. VIII. fig. 4. Very slender tibiella with curved cylindrical shaft and elongate club-shaped terminations. Length ·215 mm., thickness ·003 mm. Very similar spicules are present in *Halichondria infrequens*, Carter (Ann. & Mag. N. H. s. 5, vol. vii. 1881, p. 369, pl. xviii. fig. 9 *b*), from the Gulf of Manaar.

Pl. VIII. fig. 5. Tibiella with smooth, evenly cylindrical, regularly curved shaft and prominent club-shaped ends. Length ·133 mm., thickness ·003 mm.

Pl. VIII. fig. 6. Tibiella with smooth, cylindrical, slightly curved shaft and club-shaped extremities which are minutely spined. Length ·106 mm., thickness ·003 mm. Similar spicules occur in *Iophon cylindricus*, Ridley & Dendy (Chall. Rep. vol. xx. p. 120, pl. xvii. fig. 6 *c*), from off Cape Howe, Australia, at a depth of 120 fathoms.

The examples of tibiella spicules figured above indicate a considerable variety of form and size in the Oamaru material and they are likewise very abundant. They range from ·106 to ·765 mm. in length, and from ·003 to ·06 mm. in thickness. Tibiella spicules are present in the following genera, amongst others, of recent sponges:—*Histoderma*, Carter, *Tedania*, Gray, *Iophon*, Gray, *Myxilla*, Osc. Sch., *Forcepia*, Carter, *Sideroderma*, Ridley & Dendy, and also in some of the species placed under *Halichondria* by Carter and Bowerbank, and in *Phlœodictyon*, Carter. It will be shown further on that the distinctive flesh-spicules of several of these genera are present in the deposit. Detached tibiella spicules are present in dredgings off the S.W. coast of Australia at a depth of 2479 fathoms.

Acuate or Styliform Spicules of various Genera.

Pl. VIII. fig. 7. Acuate, with evenly rounded head, the upper half of the shaft nearly of an even thickness, then gradually tapering to an acute point. Length ·385 mm., thickness ·008 mm.

Pl. VIII. fig. 8. Large, stout, slightly curved acuate, of an even thickness for about two-thirds from the head, thence gradually tapering. Axial canal widest near the head and gradually diminishing to the apex. Length 1·5 mm., thickness ·036 mm. This is the largest form of acuate met with in the deposit. Shorter but otherwise similar spicules are present in *Amphilectus annectens*, Ridley & Dendy (Chall. Rep. vol. xx. p. 127, pl. xix. fig. 4), and also in *A. pilosus*, R. & D. (l. c. p. 126, pl. xix. fig. 5), from Kerguelen.

Pl. VIII. fig. 9. Nearly straight acuate, of approximately the same thickness to within a short distance of the apex. The head is slightly inflated but hardly sufficient to include it with spinulate forms. Length ·285 mm., thickness ·006 mm.

Pl. VIII. fig. 10. Slightly curved acuate, very gradually tapering from the head to the acutely-pointed apex. Length ·665 mm., thickness ·017 mm.

Pl. VIII. fig. 10 *a*. Robust, short, nearly straight acuate, nearly cylindrical throughout, abruptly pointed near the apex. Length ·54 mm., thickness ·04 mm.

Pl. VIII. figs. 11, 12. Evenly curved acuates, heads rounded, thickest in central portion of the shaft, tapering in lower third, somewhat abruptly pointed. Length ·56 to ·6 mm., thickness ·03 mm. Similar but slightly larger forms are present in *Myxilla hastata* and *M. spongiosa*, Ridley & Dendy (Chall. Rep. vol. xx. p. 134, pl. xxvii. figs. 1, 3), from off the mouth of the Rio de la Plata at a depth of 600 fathoms.

Pl. VIII. figs. 13, 14. Short curved acuates, thickest a short distance below the head, tapering from the lower third. Length of fig. 13, ·352 mm., thickness ·02 mm. Fig. 14, length ·175 mm., thickness ·01 mm. In this latter the axial canal is widened for a short distance below the head, whilst in fig. 13 it appears as an extremely fine even thread throughout its length.

Pl. VIII. fig. 15. Slender, elongate, slightly curved acuate, shaft thickest a little below the middle of the spicule; near the apex it tapers somewhat abruptly. Length ·485 mm., thickness ·009 mm.

Pl. VIII. figs. 16–20. Short, stout, curved, comma-shaped acuates, tapering from the middle, thickest at or near the head. Length ·095 to ·58 mm., thickness ·015 to ·04 mm. Though varying considerably in dimensions, these forms exhibit similar characters. Spicules of corresponding form and size occur in *Axinella spiculifera*, Lam., sp., and in *A. proliferans*, Ridley ('Alert' Report, pp. 617–8, pl. liv. figs. *b*, *c*), the former from King Island, Australia, the latter from Providence Island, Mascarene Group, at depths of from 18 to 22 fathoms.

Pl. VIII. fig. 41. Curved acuate, nearly uniformly cylindrical throughout, abruptly pointed near the apex. Length ·37 mm., thickness ·01 mm.

Pl. VIII. figs. 22, 23. Straight acuates, fusiform, summits evenly rounded, shafts increasing in thickness to near or below the centre, thence gradually tapering to the apex. Length ·36 to ·5 mm., thickness ·016 to ·021 mm. These forms have the same general appearance as the skeletal spicules of *Tethya*, Lam., but they are much smaller.

Pl. VIII. fig. 30. Acuate spicule, with the upper portion curved like a walking-stick, at right angles to the rest of the shaft. Head evenly rounded and thick, thence gradually tapering to the apex. The axial canal follows the curve of the head. Length ·31 mm., thickness ·025 mm.

Smooth Acuates with Bulbous Shafts.

Pl. VIII. figs. 39, 40. Approximately straight spicules, fusiform or styliform, with rounded or blunt heads, the top portion of the shaft even, below this with several bulbous inflations at irregular distances, the apices acutely pointed. The axial canal is even throughout the spicule and not inflated. Length ·53 to ·7 mm., greatest thickness of shaft ·02, of inflated portion ·028 mm. Similarly inflated spicules occur in *Phelloderma radiatum*, Ridley & Dendy (Chall. Rep. vol. xx. p. 113, pl. 23. figs. 8, 8 *a*), from off the mouth of the Rio de la Plata at a depth of 600 fathoms.

Spined Acuate Spicules.

Pl. VIII. fig. 24. Elongate slender acuate, very gradually tapering from the summit, the head thickly set with minute spines or tubercles; the rest of the shaft smooth. Length ·62 mm., thickness ·012 mm.

Pl. VIII. fig. 25. Straight acuate, very gradually and evenly tapering from the summit to the apex; upper portion of shaft smooth, the rest covered with very minute spines. Length ·51 mm., thickness ·028 mm.

Pl. VIII. figs. 26, 33. Curved acuates, nearly of an even thickness in the upper two-thirds of the shaft, then tapering slightly, abruptly pointed. Surface with very short conical spines projecting at right angles, smooth near the apex. Length ·165 to ·215 mm., thickness ·015 mm. Nearly similar forms are figured in *Halichondria Dickiei*, Bow. (Mon. Brit. Spong. vol. iii. pl. xlv. fig. 4).

Pl. VIII. fig. 27. Curved acuate, thickest in central portion, abruptly pointed; surface thickly set with stout conical spines projecting at right angles. Length ·265 mm., thickness ·025 mm.

Pl. VIII. fig. 28. Curved acuate, slightly inflated at the summit, tapering gradually in the lower half; surface covered with numerous short spines. Length ·245 mm., thickness ·019 mm.

Pl. VIII. fig. 21. Short, strongly curved acuate, upper half evenly cylindrical, then gradually tapering, abruptly pointed. Spines small, conical, numerous. Length ·12 mm., thickness ·01 mm.

Pl. VIII. fig. 34. Slightly curved acuate, gradually tapering from the rounded summit; surface evenly covered with minute spines. Length ·185 mm., thickness ·015 mm.

Pl. VIII. figs. 35, 36. Elongate acuate, upper portion curved with slightly inflated summit, lower two thirds nearly straight, gradually tapering to an acute point. In the upper portion short slightly hooked spines; in the lower the spines are smaller and sparsely distributed. Length ·51 mm., thickness ·015 mm. Fig. 36 is straight, spined like fig. 35.

Pl. VIII. fig. 30 *a*. Stout acuate, the upper portion bent nearly at right angles, thickest at the head; from thence gradually tapering to the apex, which is abruptly pointed. The bent portion of the shaft is smooth, the rest with minute conical spines; near the apex there are small, thickly set, recurved spines. Length ·235 mm., thickness ·02 mm. Mr. Carter figures spined acuates of similar form, but larger, in *Microciona intexta* (Ann. & Mag. Nat. Hist. s. 4, vol. xviii. 1876, p. 239, pl. xv. fig. 43 *a*).

Pl. VIII. fig. 31. Acuate spicule with the upper portion strongly curved like a walking-stick, and furnished with minute spines; in the straight lower portion of the shaft the spines are fewer and smaller. Length ·115 mm., thickness ·014 mm.

As shown in the figures on Pl. VIII., acuate spicules, whether smooth or spined, are very abundant in the Oamaru deposit; and they exhibit considerable variations in size, ranging in length from ·095 to 1·5 mm., and in thickness from ·006 to ·04 mm. The greater number, however, range in length between ·2 and ·5 mm., and they correspond very closely in this respect with the acuate spicules of existing sponges. Acuate spicules are present in numerous genera of recent sponges; the most important of these are *Esperella*, *Iophon*, *Esperiopsis*, *Amphilectus*, *Myxilla*, *Axinella*, and *Latrunculia*; also in some species placed by Bowerbank and Carter under *Halichondria*, *Dictyocylindrus*, *Hymeniacidon*, &c. Several of the above-named genera can be recognized in the Oamaru material by their distinctive flesh-spicules, to be described later.

Fossil acuate spicules are known from the Carboniferous limestone; they are also present in Jurassic and Cretaceous strata;

but they are rare forms, and considerably larger than those present in this deposit. Detached acuate spicules occur in dredgings off the S.W. of Australia, taken by H.M.S. 'Egeria' from a depth of 3000 fathoms.

Spinulate or Pin-shaped Spicules of various Genera.

Pl. IX. fig. 1. Stout elongate spicule, with evenly rounded head and smooth straight shaft, nearly cylindrical in the upper half, then tapering to an acute point. The axial canal with a slight inflation at the head, continuous throughout the shaft, and opening at the apex. Length 1·06 mm., thickness ·03 mm.

Suberites (a).—Pl. IX. fig. 2. Shaft straight, elongate, slender, smooth, and fusiform; head small, conical, constricted at the neck. Length ·425 mm., thickness ·013 mm. Very similar spicules occur in *Suberites senilis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 209, pl. xlv. fig. 1*a*), from the North Pacific, at a depth of 2050 fathoms.

Pl. IX. fig. 3. Stout, smooth, straight; head rounded, slightly constricted neck, very gradually tapering shaft, acutely pointed. Length 1·21 mm., thickness ·03 mm.

Pl. IX. fig. 4. Spicule straight; head rounded, with prominent spines; shaft gradually tapering, furnished with a few small spines. Length ·305 mm., thickness ·012 mm.

Cribrella (a).—Pl. IX. fig. 5. Robust, slightly curved, spinulate; head evenly rounded, bulbous, not distinctly marked off from the shaft, which gradually tapers to an acute point; the head and the upper third of the shaft covered with stout, prominent, conical spines; the rest of the shaft smooth. Length ·35 mm., thickness at summit ·045 mm. A similar, but somewhat smaller, spicule is figured by Mr. Carter in *Cribrella hospitalis*, Osc. Sch. (Ann. & Mag. N. H. s. 4, vol. xviii. 1876, pl. xv. fig. 36 *a*).

Pl. IX. figs. 6, 7, 8. Pin-shaped spicules, with straight smooth shafts; heads evenly rounded, constriction at neck, tapering in the lower half, acutely pointed. Length ·5 to ·7 mm., thickness ·02 to ·036 mm. Similar spicules are present in *Spirastrella transitoria*, Ridley ('Alert' Rep. p. 623, pl. liv. fig. *q*), from Darros Island, at a depth of 22 fathoms.

Pl. IX. figs. 9, 10, 11. Smooth, slender, curved spicules, with prominent evenly rounded heads, and shafts of the same thickness for the upper two-thirds, below this tapering to an acute point. Length ·18 to ·4 mm., thickness ·005 to ·01 mm.

Pl. IX. fig. 12. Spinulate, with well-marked rounded head; straight, fusiform, smooth shaft, acutely pointed. Length ·15 mm., thickness ·013 mm. Similar spinulates occur in *Proteleia Sollasi*, Ridley and Dendy (Chall. Rep. vol. xx. p. 214, pl. xlii. figs. 8 *e*, 8 *f*), from Simon's Bay at a depth of 10–20 fathoms.

Pl. IX. fig. 19. Small, slender spinulate, the upper portion curved; shaft slightly fusiform, smooth. Length ·115 mm., thickness ·006 mm.

Pl. IX. fig. 14. Approximately straight, smooth; head evenly round, not constricted; shaft gradually tapering to an acute point. Axial canal shown as a very delicate even thread, not inflated at the head. Length ·513 mm., greatest thickness ·045 mm.

Pl. IX. figs. 15–18. Straight nail-like spinulates, with rounded well-defined heads, which are either covered with blunted spines or tubercles or quite smooth; the shafts taper from the head and are spined throughout; the spines in the upper portion projecting at right angles, whilst lower down the shaft they are oblique, pointing to the head of the spicule. Length ·085 to ·175 mm., thickness of shafts ·005 to ·02 mm. Spined spinulates resembling these are figured by Bowerbank in the recent *Hymeraphia clavata* and in *H. simplex* (Mon. Brit. Spong. vol. iii. pl. xxvi. fig. 9, pl. lxxx. fig. 3); and Dr. Rüst figures a similar form from the Jurassic strata of Ilsede, Hanover (Palæontographica, Bd. 31, pl. xx. fig. 5).

Pl. VIII. figs. 37, 37*a*, 38. Spicules straight, nail-like in form; heads rounded or flattened, with very prominent spines, projecting horizontally or recurved, sometimes with a verticillate arrangement; shafts gradually tapering to an acute point, provided with minute spines directed upwards towards the head of the spicule. Length ·073 to ·116 mm., thickness ·006 to ·01 mm. Somewhat similar spinulates are figured by Bowerbank in *Hymeraphia coronula* (Mon. Brit. Spong. vol. iii. p. 246, pl. lxxix. figs. 3, 4). A form similar to 37*a* is figured by Osc. Schmidt in *Stelletta pumex* (Adriat. Spong. Suppl. i. p. 32, pl. iii. fig. 9 *a*); but that it really belongs to a species of *Stelletta* is very doubtful.

Abnormal Spinulate.

Pl. VIII. fig. 29. Spicule with subcylindrical curved shaft, at the head of which several prominent rounded tubercles are grouped. The axial canal has a small bulbous inflation at the summit. Of this form, only the upper portion of a spicule is known. The shaft is ·045 mm. in thickness.

Spinulate or pin-shaped spicules, though very abundant, are relatively less numerous in the Oamaru material than the acuate and acerate forms. They vary considerably in size; small forms not exceeding ·1 mm. in length by ·01 mm. in thickness, whilst the larger reach to 1·21 mm. by ·045 mm. They correspond very fairly with the spinulate spicules in recent sponges of the Clavulina group belonging to the following genera: *Suberites*, *Polymastia*, *Cliona*, and *Spirastrella*. Similar spicules are also present in *Esperella* and *Axinella*. That some of the fossil spinulates most probably belonged to *Spirastrella* is shown by the occurrence of the characteristic spiral flesh-spicules of this genus in the deposit. As detached, in dredgings by H.M.S. 'Egeria' off the S.W. of Australia, they are present at depths of 2479 fathoms.

Grapnel Spicule of Acarnus, *Gray*.

Pl. IX. fig. 13. Spicule with evenly rounded head and straight subcylindrical shaft, which terminates abruptly in a slight inflation, from which five or six rays with recurved ends extend in a generally horizontal direction. The axial canal has a slight bulbous expansion in the head, thence it extends as a delicate thread to the opposite end, where it is slightly enlarged, and apparently sends out branches into the rays. The length of the spicule is ·21 mm. by ·015 mm. in thickness. Spicules nearly corresponding in form and size occur in the recent *Acarnus Wolffgangi*, Keller (Zeit. f. wiss. Zool., Bd. 48, 1889, p. 399, t. xxv. f. 56), from the Red Sea. The larger skeletal spicules of this genus are acuates and tibiellas, similar to those which have been already referred to. A detached grapnel spicule of *Acarnus* with three simple rays is present in a dredging off the S.W. coast of Australia at a depth of 2479 fathoms.

Forceps or Hair-pin Flesh-Spicules of Forcepia, *Carter*.

Forcepia Carteri, n. sp.—Pl. IX. figs. 20, 21. Spicule curved, resembling a hair-pin, the arms subcylindrical, thickest at the curve; at their ends they are slightly divergent, and one is a little longer than the other; each arm terminates with a convex slightly expanded cap or bulb. The surface covered with very minute spines; those on the arms are recurved in the direction of the curve of the spicule. Length ·036 mm., thickness of arms ·0053 mm., distance between the ends ·108 mm. This rare form is clearly allied to the flesh-spicules of *Forcepia*, Carter (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 248, pl. xv. fig. 47), originally based on detached fossil spicules from Panama, and subsequently on recent sponges, which, in addition to the flesh-spicule, possess acuate and tibiella skeletal spicules, and in some cases minute anchorates and hooks as well. The Oamaru spicule (fig. 20) is closest allied to the forceps in *Forcepia* (*Halichondria*) *bulbosa*, Carter, sp. (Ann. & Mag. N. H. s. 4, vol. xviii. p. 312, pl. xiii. figs. 19 *e*, *f*, *g*); but it differs in the curvature and divergence of the arms, and may be accepted as indicating a new species, which may be termed *Forcepia Carteri*. According to Vosmaer's figures, the forceps spicules in the recent *F. bulbosa* vary considerably in details (Bronn's Klass. u. Ordn. des Thierreichs, Porifera, Taf. xvi. fig. 37, Taf. xxi. figs. 5, 6). One recent species, *F. colonensis*, Carter, with comparatively large forceps, is found at Port Phillip Heads, Australia. It is worthy of note that in a spicule so minute as the one figured on the scale of 600 diameters there is a close correspondence with the spicules of existing forms in such small details as the unequal length of the arms and the downward direction of the surface spines. In another spicule, probably referable to the same sponge (Pl. IX. fig. 21), the arms diverge so as to form an open curve, and they have a small convex cap on their ends.

Forcepia Vosmaeri, n. sp.—Pl. IX. fig. 22. Forceps spicule, the arms nearly straight, tapering, thickest at the curve, subparallel with each other, slightly unequal in length, abruptly truncate, and divergent near their apices. The surface thickly covered with minute spines projecting directly outwards. A continuous axial canal extends throughout the spicule. Length ·068 mm., greatest thickness at curve ·0087 mm. This differs considerably from the preceding forms, and from the forceps of other recent sponges. It probably belongs to a distinct species, which may be known as *Forcepia Vosmaeri*.

Bow-shaped or Tricurvate Flesh-Spicules of Amphilectus, *Vosmaer*.

Pl. IX. fig. 23. Smooth, slender, tricurvate, nearly evenly cylindrical, with subangular central bend. Length, from end to end, ·21 mm., thickness ·005 mm. Similar but larger spicules are present in *Amphilectus pilosus*, Ridley and Dendy (Chall. Rep. vol. xx. p. 126, pl. xix. fig. 5 *b*), from Kerguelen at depths of 50 to 70 fathoms.

Pl. IX. fig. 24. Tricurvate, smooth, with open central curve, extremities pointed. Length ·096 mm., thickness ·006 mm. A similar but slightly longer spicule is figured by Ridley in *Amphilectus tibiellifer* ('Alert' Rep. p. 428, pl. xlii. fig. *t*), from Torres Straits.

Tricurvate spicules are of rare occurrence in the Oamaru material. Though the forms described are referred to *Amphilectus*, the same kind of flesh-spicule is common to *Desmacidon*, *Esperella*, *Hamacantha*, and other genera of recent sponges.

Hook-shaped or Bihamate Flesh-Spicules of Esperella, *Vosmaer, and other Genera.*

Pl. IX. fig. 25. Spicule slender, C-shaped, nearly of an even thickness throughout, regularly curved. Height ·076 mm., thickness ·003 mm.

Pl. IX. fig. 26. Small, slender, abruptly curved in the centre, ends acute, sharply bent inwards. Height ·05 mm., thickness ·003 mm.

Pl. IX. fig. 27. Spicule C-shaped, very evenly rounded. Height ·13 mm., thickness ·006 mm. This form resembles the hook-spicules of *Gellius glacialis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 41, pl. xiii. figs. 12, 15), from the Agulhas Bank at a depth of 150 fathoms.

Pl. IX. fig. 28. Spicule stout, very openly curved, partly contort, ends acute, curved inwards. Height ·205 mm., thickness ·01 mm.

Pl. IX. fig. 29. Spicule small, evenly curved, ends very acute. Height ·06 mm., thickness ·003 mm.

Pl. IX. fig. 30. Stout spicule, C-shaped, ends contort, sharply bent inwards. The axial canal distinctly shown, traversing the specimen and opening at the ends. Height ·185 mm., thickness ·011 mm. Similar but somewhat larger spicules are present in *Cladorhiza moruliformis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 90, pl. xxi. fig. 15), from the Southern Ocean, south-west of Australia, at a depth of 1950 fathoms.

Pl. IX. fig. 31. Small hook-shaped, ends contort, abruptly bent, acutely pointed. Height ·043 mm., thickness ·0026 mm.

Pl. IX. fig. 32. Stout hook-shaped, ends evenly but narrowly rounded. Axial canal continuous through the spicule and opening at both ends. Height ·46 mm., thickness ·018 mm.

Bihamate spicules of the same character as those referred to above are more especially present in the following genera of recent sponges: *Esperella*, *Amphilectus*, *Myxilla*, *Forcepia*, and *Cladorhiza*. Bihamate spicules are known as fossil from the Lower Lias upwards; but, as rule, those which have hitherto been recognized from the Cretaceous and lower rocks are considerably larger than those from Oamaru and in recent sponges.

Clasp-hook or Trenchant Bihamate Flesh-Spicules of Hamacantha, *Gray*.

Hamacantha Johnsoni?, Bowk., sp.—Pl. IX. fig. 33. Spicule robust, smooth; shaft nearly straight or with a slight curve, the inner edge with a faintly-marked shallow curve. Ends contort, barbed, with distinct circular notch at the bend. Axial canal continuous throughout the spicule, and opening at the ends of both the hooks. Height ·15 mm., greatest thickness of shaft, including edge, ·02 mm. A similar but smaller spicule is represented in fig. 37.

Another form (Pl. IX. fig. 34) is nearly similar to the preceding (fig. 33), but with a well-marked open notch or curve in the central portion of the inner edge of the shaft. Axial canal shown, but it is much finer than in the preceding. The barbed ends may be either symmetrical or contort in various degrees, just as in recent spicules of the same kind. These spicules (figs. 33, 34) are strikingly similar in form and size to those of the recent *Hamacantha* (*Hymedesmia*) *Johnsoni*, Bowk., sp. (Mon. Brit. Spong. vol. i. p. 247, pl. v. fig. 112), from Madeira, and in the same species from near the Faroe Islands, as figured by Mr. Carter (Ann. & Mag. N. H. s. 5, vol. ix. 1882, p. 296, pl. xi. fig. 21 *c*, *d*). They correspond equally closely with those in *Vomerula esperoides*, Ridley and Dendy (Chall. Rep. vol. xx. p. 60, pl. xvii. fig. 2*a*, *b*), from the Agulhas Bank and off the Rio de la Plata; and these again, according to the same authors, are similar to the spicules in *Hamacantha papillata*, Vosm. (Spong. Willem Barent's Exp. p. 28). It may be doubted if there are sufficient grounds for separating *Vomerula*, Osc. Sch., from *Hamacantha*, Gray. In addition to the distinctive flesh-spicules, there are in the Oamaru material the corresponding acerate and acuate skeletal spicules of *Hamacantha*; so that it is safe to conclude that sponges of this genus were present.

Hamacantha Huttoni, n. sp.—Pl. IX. fig. 35. Robust bihamate, having a curved shaft with wide laminar inner margin; rounded above and below; hooks barbed, projecting outwards so as to leave open oval notches beneath the curves at both ends. A well-marked axial canal is continuous throughout the spicule, and opens at the extremity of the hooks. Height ·22 mm., greatest width of shaft ·027 mm. This spicule probably belongs to a new species, which may be termed *Hamacantha Huttoni*, after Capt. F. W. Hutton, F.G.S., to whom we are indebted for first sending over the Oamaru material to this country.

Hamacantha ?, sp.—Pl. IX. fig. 36. Robust bihamate; shaft slightly curved, cylindrical, either without an inner laminated flange, or having a slightly developed edge near both ends, which are evenly rounded without a distinct notch; extremities acute, with flanges and barbs directed outwards. Height ·205 mm., thickness of shaft ·012 mm. This form is intermediate in character between the ordinary C-shaped bihamates, such as that figured, Pl. IX. fig. 32, and the normal bihamates of *Hamacantha*, Pl. IX. fig. 34; the flanges and notches of the shaft in this latter are not developed, whilst the hamate ends are similar. Bihamates in which the *Hamacantha* characters are still less developed than in this fossil occur in *Esperella Simonis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 73, pl. xv. fig. 13), from Simon's Bay, 15–20 fathoms.

Flesh-Spicules of Melonanchora, *Carter*.

Melonanchora (a).—Pl. IX. fig. 39. Equianchorate with smooth evenly-curved shaft and unusually long, slender, curved teeth, which are bent over so that those of the opposite ends are nearly in contact or overlap each other. Falces very prominent. Length of spicule ·066 mm., of the teeth ·034 mm., thickness of shaft ·007 mm. Only a lateral view of this spicule has been recognized, but it accords so materially with the same aspect of the larger anchorates in *Melonanchora elliptica*, Carter (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 212, pl. xiii. fig. 11), the type of the genus, that there is little doubt of the relationship. In size also the fossil corresponds closely with the recent spicule, but the teeth in this latter, judging from the figures, are less developed. Osc. Schmidt has already pointed out that this form cannot be considered as the young or immature stage of the melon-shaped spicule of the same species as supposed by Mr. Carter (Spong. Mexico, p. 85).

Melonanchora Morlandi, n. sp.—Pl. IX. fig. 38. Spicule oval or melon-shaped in outline; ends narrowly rounded, sides evenly curved, and of about an even width, a regular well-marked sub-circular inner notch at both ends, but none in the centre. Outer margins smooth and even, the laminæ gradually thinning to a knife-like edge; a definite axial canal extending quite round the spicule just within the margin. Traces of transverse striæ across the walls. Length of spicule ·13 mm., width ·08 mm. Thickness or width of the wall ·018 mm.

The character of this spicule may be understood if we suppose the shafts only of two of the ordinary bihamate spicules of *Hamacantha*, like those represented on Pl. IX. fig. 33, placed *vis-à-vis*, and welded into a single spicule, which would then have the same outline, the same circular notch at the ends, and the same knife-edge at the inner margin as the present fossil; further, if the canals in the *Hamacantha* spicules were connected together they would also resemble the continuous axial canal of the melon-spicule. As compared with the melon-shaped spicule of the recent *Melonanchora elliptica*, Carter (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 212, pl. xiii. figs. 6–12, pl. xv. figs. 35 *a*, *b*), the present fossil has the remarkable peculiarity that it only includes one-half the recent form, for whilst the recent spicule consists of two oval frames at right angles to each other, the fossil possesses only one, and yet it has every appearance of being complete. Beyond that the fossil is larger than the recent "melon" spicule and has not the notch in the middle of the inner margin, there is considerable similarity to the recent form. It indicates a new species of the genus, which may be termed *Melonanchora Morlandi*, in honour of Mr. H. Morland, to whom we are indebted for the discovery of this spicule in the Oamaru material. The skeletal spicules of the recent type species of *Melonanchora* are, according to Mr. Carter, simple acuates and tibiellas, of similar proportions to some of those in the Oamaru material figured on Pls. VIII. and IX. The recent species is only known from the North Atlantic and from the Caribbean Sea (Spong. Mexico, p. 85, t. ix. fig. 8).

Anchorate Flesh-Spicules of Myxilla, Desmacidon, *and allied Genera.*

Myxilla? (a).—Pl. IX. figs. 41–44. Equianchorate spicules with strongly curved shafts, and elongate, acutely-pointed teeth. Average length of spicule ·071 mm., of the teeth ·017; thickness of shaft ·01 mm.

Myxilla (b).—Pl. IX. fig. 48. Equianchorate with relatively short, thick, curved shaft, and three simple teeth at each end. Length of spicule ·026 mm., of teeth ·0083 mm., width across teeth ·013 mm., thickness of shaft ·007 mm. This form is of the same character as that shown in fig. 40, but the shaft is not inflated. Somewhat similar anchorates are present in *Myxilla compressa*, Ridley and Dendy (Chall. Rep. vol. xx. p. 139, pl. xxvii. fig. 9 *d*), from off the mouth of the Rio de la Plata, 600 fathoms.

Pl. IX. figs. 49, 50. Spicules with strongly curved, stout shaft and prominent curved teeth; the lateral teeth at either end of the spicule are extended so as to form claw-shaped processes. In size the spicules correspond with the preceding (fig. 48).

Pl. IX. fig. 53. Equianchorate spicule with strongly curved shaft and short stout blunt teeth, which openly diverge from the shaft. Length of spicule ·031 mm., of teeth ·012 mm., thickness of shaft ·0053 mm. This spicule is of the same type as the foregoing (figs. 48, 49, 50), but it is larger, and further distinguished by the blunted character of the teeth and their open disposition.

Myxilla (c).—Pl. IX. fig. 45. Equianchorate with stout even shaft, ends triangular, the lateral teeth nearly straight, margins infolded, with prolonged incurved, hook-like extremities. Anterior teeth narrow, elongate. Length of spicule ·037 mm., of lateral teeth ·013 mm., thickness of shaft ·017 mm. Similar spicules are present in *Myxilla arborescens*, Ridley ('Alert' Rep. p. 430, pl. xlii. fig. a''), from shallow water at Port Jackson, but their shafts are less robust and the lateral teeth obtuse.

Myxilla (d).—Pl. IX. fig. 46, Pl. X. figs. 46, 47. Equianchorates with robust shaft and regularly curved simple teeth. Length of spicule ·031 mm., of the teeth ·011 mm., width across teeth ·016 mm., thickness of shaft ·005 mm.; Pl. X. fig. 47 is a lateral view of probably the same spicule. These spicules correspond with the equianchorates of *Myxilla nobilis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 140, pl. xxvii. figs. 15 *c*, *d*), from off the Crozet Islands, at depths from 240–550 fathoms.

Pl. IX. figs. 47, 47 *a*. Small equianchorates, shafts curved, teeth short, simple. Fig. 47 is a front view; 47 *a* is a lateral view of a similar but larger form. Length of spicule (fig. 47) ·016 mm., width across teeth ·0067 mm., thickness of shaft ·0016 mm.

Pl. IX. figs. 51, 52. Small equianchorates with stout curved shafts, ends rounded, and short, simple teeth. Length of spicule ·036 mm., width across teeth ·02 mm., thickness of shaft ·006 mm. Fig. 52 is a lateral view of probably the same spicule.

Pl. IX. figs. 54, 55. Equianchorates with stout shafts, rounded ends, and simple slightly extended teeth. Length (fig. 54) ·046 mm., width across teeth ·016 mm., thickness of shaft ·006 mm.

Myxilla (e).—Pl. X. fig. 21. Equianchorate with strongly curved shaft, and having the lateral teeth much extended and curved inwards, so that they nearly meet each other. Anterior tubercle elongate. Length of spicule ·04 mm., of lateral teeth ·017 mm., width across teeth ·016 mm., thickness of shaft ·0033 mm.

Myxilla (f).—Pl. X. fig. 22. Lateral view of equianchorate with an evenly curved shaft and short incurved obtuse teeth. Length of spicule ·027 mm., of teeth ·006 mm., thickness of shaft ·005 mm. Detached spicules of this form are present in the 'Egeria' dredgings off the S.W. coast of Australia, at a depth of 3000 fathoms.

Myxilla (g).—Pl. X. fig. 30. Equianchorate with slightly curved shaft and long slender upright teeth. Length of spicule ·051 mm., of teeth ·02 mm., thickness of shaft ·005 mm. Only the lateral view known.

Myxilla (h).—Pl. X. fig. 48. Equianchorate with sharp harpoon-like ends; the lateral teeth triangular, acutely pointed, anterior teeth outwardly projecting. Length of spicule ·037 mm., of teeth ·014 mm., width across teeth ·015 mm., thickness of shaft ·007 mm. This spicule is distinguished by the angular ends and the long slender teeth. Somewhat similar but smaller equianchorates are present in *Myxilla veneta*, Osc. Sch. (Adriat. Spong. p. 71, pl. vii. fig. 4 *c*).

Myxilla Dendyi, n. sp.—Pl. X. figs. 49–52. Anchorate spicules with stout curved shaft having three palms or teeth at the upper end; the lateral ones widely extended and curved, horn-like, the central tooth projecting prominently forwards and downwards. The opposite end of the spicule is subtriangular, the lateral palms with revert margins inwardly curved above, and a prominent elongate tubercle with rounded ends. Length of spicule ·037 mm., width across upper palms ·025 mm., length of lower palms ·025 mm., thickness of shaft ·01 mm. Fig. 49 is a front view, and figs. 50, 51 lateral views of the same form of spicule. Fig. 52 is a much smaller form which may be only a young stage of the larger spicules. In a front view of this, the central tubercle (?) of the upper end projects as a circular or slightly elliptical process, and beneath it is an elongate spatulate tooth or palm; the tubercle of the lower end of the spicule is subtriangular in outline. The length of this spicule is ·02 mm., width across the teeth ·014 mm.

The only recent spicules with which these forms can be compared are some peculiar anchorates described by Osc. Schmidt in *Sceptrella regalis*, from off Florida (Atlant. Spong. p. 58, pl. v. fig. 24 *c*). In these the larger end of the spicule is proportionately less widely extended than in our fossils, but the anterior palm has a similarly projecting tongue-shaped process. According to Osc. Schmidt, these anchorates are associated with "sceptrella" spicules; but Mr. H. J. Carter, and subsequently Ridley and Dendy, consider that this association of such different forms in one sponge arises from a mistake, and that the anchorates really belong to a species of *Myxilla* (Ann. & Mag. N. H. s. 5, vol. iii. 1879, p. 359; Chall. Rep. vol. xx. p. lxii, note). In accordance with this view, the present fossil spicules may be referred to *Myxilla*, and as they indicate a new species, it may be termed *Myxilla Dendyi.*

Desmacidon (a).—Pl. IX. fig. 40. Short stout equianchorate, the central portion of the shaft inflated, with neck-like constrictions above and below; teeth curved, stout, bent inwards, anterior prominent. Length of spicule ·028 mm., of teeth ·01 mm., greatest width of shaft ·01 mm. The anchorates in *Desmacidon tunicata*, Os. Sch. (Atlant. Spong. p. 55, pl. v. fig. 21 *b*), are approximately similar to this form, but their shafts are not inflated.

Desmacidon (b).—Pl. X. fig. 36. Equianchorate with curved shaft, slightly constricted in the middle and at both ends; lateral teeth or palms stout, evenly curved, anterior tubercles ovate, prominent tongue-shaped anterior palms. Length of spicule ·073 mm., of teeth or palms ·023 mm., width across them ·03 mm., greatest thickness of shaft ·015 mm. This form resembles the anchorates in an Australian variety of *Desmacidon fruticosa*, Montagu, sp., figured by Ridley and Dendy (Chall. Rep. vol. xx. p. 104, pl. xxiii. figs. 10 *b*, *c*), but it is about twice as large. It corresponds also with Mr. Carter's figures of the equianchorate of *Halichondria incrustans*, Bow. (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 208, pl. xiii. figs. 1 *a*, *b*, *c*). The lateral view of probably a similar spicule is shown in fig. 41.

Desmacidon (c).—Pl. X. figs. 38, 39. Equianchorate with curved shaft, lateral teeth somewhat incurved and extended below into a claw-like process; anterior tubercles elongate, anterior palm tongue-shaped. Length of spicule ·05 mm., of teeth ·019 mm., width across teeth ·26 mm., thickness of shaft ·006 mm. Fig. 38 is the front, and fig. 39 the lateral view of the same spicule.

Halichondria (a).—Pl. X. fig. 40. Equianchorate with strongly curved shaft, so that, viewed laterally, it is G-shaped; teeth incurved, obtuse, central lamina very prominent. Length of spicule ·046 mm., of teeth ·016 mm., thickness of shaft ·0067 mm. The lateral aspect of this spicule resembles that of the equianchorates of *Halichondria pustulosa*, Carter (Ann. & Mag. N. H. s. 5, vol. ix. 1882, p. 286, pl. xi. fig. 1*f*), from near the Falkland Islands at depths of 50–70 fathoms.

Halichondria (b).—Pl. X. fig. 42. Equianchorate with strongly curved and apparently somewhat contort shaft; teeth elongate, inwardly curved and acutely pointed, anterior falces very prominent. Length of spicule ·034 mm., of teeth ·015 mm., thickness of shaft ·0041 mm. Only a lateral view of this spicule is known. It is of the same character as the preceding (fig. 40), but smaller, and the teeth are proportionately longer, so that they overlap each other in the middle of the spicule.

Pl. X. fig. 43. Equianchorate with unusually long curved shaft and short obtuse teeth. Only the lateral aspect known. Length of spicule ·038 mm., of teeth ·0042 mm., thickness of shaft ·0033 mm.

It will be seen from the foregoing descriptions that the anchorate flesh-spicules of the types of those occurring in *Myxilla* and *Desmacidon* are very abundant and varied in the Oamaru material, and making due allowance for the possibility that in some species more than one form of anchorate may be present, it seems probable that at least twelve species of one or other of these genera are represented.

Palmate Inequianchorate Flesh-Spicules of Esperella, *Vosmaer* (=Esperia, *Nardo*).

Esperella (a).—Pl. X. figs. 1, 2. Large, robust, inequianchorate with slightly curved shafts, somewhat thicker near the larger end. The lateral palms curved and extended inferiorly to an acute point, directed inwards, outer margins strongly reverted; anterior palm tongue-shaped, the broad end slightly projecting above the general curve of the head, tubercle pear-shaped. Smaller end of the spicule narrow, the lateral palms with revert margins, tubercle nearly oval. Length of spicule ·175 mm., of anterior palm ·075 mm., width of larger end ·085 mm., of smaller ·06 mm., greatest thickness of shaft ·035 mm. The axial canal is well shown traversing the shaft from the lower to the upper tubercle. In general form this spicule closely resembles the large inequianchorates of *Esperia diaphana*, Osc. Sch. (Atlant. Spong. p. 57, t. iv. fig. 13), but if Schmidt's measurements of these are correct, the Oamaru forms are considerably smaller.

Esperella (b).—Pl. X. fig. 3. Inequianchorate with large upper end, the lateral palms evenly curved, rounded inferiorly and not extended, the margins reverted, anterior palm elliptical, tubercle elongate pear-shaped; the lower end of the spicule subquadrate, anterior palm extending nearly the whole width, tubercle subtriangular. Length of spicule ·086 mm., of larger end ·051 mm., width of same ·04 mm., length of anterior palm ·043 mm., length of smaller end of spicule ·013, width ·023, thickness of shaft ·006 mm. This form corresponds with the large inequianchorates in *Esperia anceps*, *E. syrinx*, and *E. Lorenzii*, figured by Osc. Schmidt (Adriat. Spong. p. 56, pl. v. figs. 5 *a*, *b*, 6 *a*, *b*, 7 *a*, *b*), but the recent forms are somewhat larger, and their larger ends proportionately smaller than in this fossil.

Esperella (c).—Pl. X. fig. 4. Inequianchorate with large semi-elliptical upper end, having the lateral palms very evenly curved, the margins reverted, and the lower angles slightly projecting; anterior palm tongue-shaped, produced below the level of the laterals, tubercle distinct, diamond-shaped. Smaller end of spicule semi-elliptical, lateral palms with faintly marked margins; tubercle wedge-shaped, with small processes on either side terminated by tubercles; shaft slender. Length of spicule ·07 mm., of larger end ·043 mm., widthof same ·034 mm.; length of anterior palm ·051 mm., width ·017 mm. Smaller end, length ·013 mm., width ·019 mm., thickness of shaft ·003 mm. Axial canal clearly shown.

Esperella (d).—Pl. X. fig. 5. Inequianchorate, large end rounded, lateral palms evenly curved, not prolonged below, anterior tubercle large, pear-shaped; small end of spicule oblong, lateral margins strongly reverted, central tubercle large, ovate. Shaft stout. Length of spicule ·066 mm., of larger end ·035 mm., width the same; length of smaller end of spicule ·012 mm., width ·02 mm.; thickness of shaft ·006 mm. The axial canal extends through the shaft from one tubercle to the other.

Esperella (e).—Pl. X. fig. 6. Inequianchorate with semi-elliptical larger end, the margins of the lateral palms evenly curved and revert, tubercle large, pear-shaped, anterior palm shorter than the lateral; smaller end of spicule subquadrate, central tubercle ovate, prominent, extending below the level of the base; shaft robust. Length of spicule ·043 mm., of larger end ·023 mm., length of smaller end ·006 mm., width ·016 mm., thickness of shaft ·0083 mm.

Esperella (f).—Pl. X. fig. 11. Inequianchorate with the large end semi-elliptical, rounded above, lateral palms curved above, sides nearly straight, tubercle distinct, pear-shaped, anterior palm tongue-shaped. Smaller end of spicule subquadrate, with nearly straight base, margins slightly revert, tubercle elongate, anterior palm with curved upper margin extending across the end. Length of spicule ·06 mm., of larger end ·036 mm., width ·027 mm. Length of smaller end ·01 mm., width ·015 mm., thickness of shaft ·005 mm. Axial canal distinctly shown. This form resembles the large inequianchorate in *Esperella Simonis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 73, pl. xv. fig. 16), from Simon's Bay, at depths of 10–20 fathoms.

Esperella (g).—Pl. X. fig. 12. Inequianchorate with the larger end semi-elliptical in outline, lateral palms evenly curved, margins revert, rounded inferiorly, tubercle diamond-shaped, distinct; anterior palm short, but doubtful if it is complete. Small end of spicule with slightly curved base, narrower below, tubercle conical, slightly projecting below the base. Axial canal extending from the upper to the lower tubercle. Length of spicule ·076 mm., of large end ·046 mm., width of same ·038 mm. Length of small end of spicule ·012 mm., width ·02 mm. Shaft ·006 mm. thick.

Esperella (h).—Pl. X. fig. 13. Inequianchorate, large end semi-elliptical; large prominent pear-shaped tubercle, the upper end projecting beyond the summit. Small end of spicule sub-oblong; prominent ovate tubercle, base nearly straight. Length of spicule ·076 mm., of large end ·04 mm., width ·36 mm. Length of small end ·013 mm., width ·023 mm. Thickness of shaft ·013 mm. This form differs from the preceding in the thicker shaft and larger tubercles at the upper end. It corresponds in form with the large inequianchorate figured by Ridley in *Esperia gelatinosa* ('Alert' Rep. p. 611, pl. liv. fig. *f'*), from near Providence Island, Mascarene Group.

Esperella (i).—Pl. X. fig. 14. Inequianchorate with semi-ovate larger end, the lateral palms with evenly curved revert margins, projecting slightly below and arched inferiorly. Tubercle large, pear-shaped, anterior palm tongue-shaped. Small end of spicule evenly rounded, central tubercle triangular; anterior palm extending across base, upper margin convex. Length of spicule ·086 mm., of larger end ·053 mm., width ·04 mm. Length of small end ·016 mm., width ·023 mm., thickness of shaft ·0067 mm.

Esperella (k).—Pl. X. fig. 15. Inequianchorate with large end subtriangular in outline; lateral palms, margins curved, slightly prolonged inferiorly; lower end with rounded base. Length of spicule ·08 mm., of larger end ·036, length of smaller end ·01, width ·02. Only the lateral view of this spicule is known.

The foregoing spicules (Pl. X. figs. 3–6, 11–15) all exhibit the same general characters as the large inequianchorates in recent species of *Esperella*, and they differ from these and from each other only in minor details. It is probable that each form represents a distinct species.

Esperella (l).—Pl. X. fig. 7. Small inequianchorate with strongly curved shaft, the larger end with evenly rounded lateral palms and very prominent anterior tubercle. Small end of spicule subquadrate in outline, with an ovate subcentral tubercle. Length of spicule ·034 mm., of large end ·022 mm., width

·023 mm., length of small end ·01; thickness of shaft ·003 mm. Only an oblique view of this form is known.

Esperella (m).—Pl. X. fig. 8. Inequianchorate with large end triangular in outline, tubercle distinct, narrow, elongate; anterior palm short, truncate, not extending below the tubercle. Small end rounded, central tubercle ovate. Length of spicule ·048 mm., of large end ·028 mm., width ·02 mm. Length of small end ·012 mm., thickness of shaft ·0066 mm.

Pl. X. figs. 9, 10. Lateral views of inequianchorates very similar to the preceding (fig. 8).

Esperella (n).—Pl. X. fig. 16. Inequianchorate with large end semi-ovate in outline, lateral palms evenly curved, rounded inferiorly, tubercle elongate, anterior palm prominent, rounded; small end of spicule subangular, lateral margins oblique, widest above; tubercle elongate. Axial canal extending from upper to lower tubercle. Length of spicule ·036 mm., of large end ·021 mm., width of same ·022 mm. Length of small end ·011 mm., thickness of shaft ·0045 mm. Similar but slightly larger spicules occur in *Esperella porosa*, Ridley and Dendy (Chall. Rep. vol. xx. p. 70, pl. xv. fig. 17), from Port Jackson, at depths from 30 to 35 fathoms.

Esperella (o).—Pl. X. fig. 17. Inequianchorate with nearly ovate large end; lateral palms evenly curved with rounded bases, tubercle diamond-shaped, anterior palm extending the full length of the head. Small end of spicule semicircular; tubercle ovate, distinct. Axial canal connecting the tubercles. Length of spicule ·031 mm., of large end ·021 mm., width ·011 mm., length of small end ·0053, thickness of shaft ·0046 mm. Very similar spicules are figured by Mr. Carter in *Esperia serratohamata* (Ann. & Mag. N. H. s. 5, vol. vi. 1880, p. 49, pl. v. fig. 20 *d*), from the Gulf of Manaar.

Esperella (p).—Pl. X. fig. 18. Inequianchorate with curved shaft, large end with lateral curved palms, slightly extended inferiorly, tubercle ovate. Small end with round tubercle and lateral palms appearing as small knobs in the lateral position in which the spicule is figured. Length of spicule ·022 mm., of large end ·015 mm., width ·01 mm. Width of small end ·0075 mm., thickness of shaft ·0025 mm.

Esperella (q).—Pl. X. fig. 20. Only the lateral aspect of this inequianchorate is known. The large end has the palms curved and slightly extended inferiorly; the small end viewed laterally has the form of a simple hook. A similar inequianchorate is figured by Hansen in *Esperia bihamatifera*, Vosmaer (Norw. North Atlant. Exp., Spong. 1876–8, pl. iii. fig. 5).

Iophon?—Pl. X. fig. 19. Inequianchorate with large end semi-ovate in outline, lateral palms evenly curved, slightly extended below, base evenly rounded, tubercle elongate ovate, anterior palm elliptical. Small end round at base, with prominent tubercle and two lateral teeth projecting obliquely upwards. Length of spicule ·053 mm., of larger end ·023 mm., width ·026 mm., thickness of shaft ·006 mm. In the character of the small end of the spicule this form resembles some of the inequianchorates belonging to *Iophon*, e. g. *I. abnormalis*, Ridley and Dendy (Chall. Rep. vol. xx. p. 122, pl. xvii. figs. 7, 8).

Equianchorate Flesh-Spicules of Esperiopsis, *Carter*.

Esperiopsis (a).—Pl. X. fig. 23. Equianchorate elongate, navicular, the ends semi-elliptical, lateral palms evenly curved, rounded below, tubercles ovate, anterior palms the same width as the spicule, bases truncate. Axial canal extending between the tubercles. Length of spicule ·053 mm., of the palmate ends ·023 mm., width ·015 mm., thickness of shaft ·0066 mm. This form is very similar to the equianchorates of the recent *Esperiopsis profunda*, Ridley and Dendy (Chall. Rep. vol. xx. p. 83, pl. xix. fig. 1 *b*), from the Crozet Islands, Southern Ocean, in a diatom ooze at a depth of 1600 fathoms.

Esperiopsis (b).—Pl. X. fig. 24. Navicular equianchorate with subtriangular palmate ends, lateral palms with slightly curved margins, bases nearly straight, tubercles distinct, subtriangular, shaft slender, curved. Axial canal connecting the tubercles at either end. Length of spicule ·056 mm., of the palmate ends ·025 mm., width of same ·016 mm., thickness of shaft ·003 mm.

Esperiopsis (c).—Pl. X. fig. 26. Equianchorate, elliptical in outline, lateral palms evenly curved, margins slightly revert below, tubercles elongate, distinct, anterior palms nearly as wide as the spicule, bases nearly straight. Length of spicule ·05 mm., of the palmate ends ·02 mm., width ·023 mm., thickness of shaft ·004 mm.

Pl. X. fig. 25. This is the lateral view of an equianchorate of the same size as the preceding (fig. 26), but having the shaft apparently wider.

Esperiopsis (d).—Pl. X. figs. 27, 28, 29. Stout equianchorate, lateral palms curved, margins revert, rounded below, tubercles elongate, anterior palms tongue-shaped. Length of spicule ·11 mm., of palms ·043 mm., width of same ·047 mm., thickness of shaft ·014 mm. This is one of the largest equianchorates known. Forms similar, but somewhat smaller, occur in *Esperiopsis pulchella*, Ridley and Dendy (Chall. Rep. vol. xx. p. 85, pl. xix. figs. 9 *a*, *b*), from the south-west of New Guinea, depth 140 fathoms. Figs. 27, 29 represent front views, and fig. 28 is a side view of this form.

From the above descriptions it may be concluded that at least four species of *Esperiopsis* are present in the Oamaru material. The skeletal spicules in the recent species are acuate or styliform, and very similar corresponding forms are abundant in the fossil deposit.

Inequianchorate Flesh-Spicule of Cladorhiza, *Sars*.

Cladorhiza Haasti, n. sp.—Pl. X. fig. 35. Spicule tridentate, one end much larger than the other; at the large end three prominent teeth—the lateral extending obliquely outwards, and the anterior projecting forward; shaft curved, strongly alate, the alæ widest near the upper end, and gradually tapering; at the small extremity the shaft is curved, so that it becomes at right angles to the main portion, and at the end there is a small triangular tubercle from which three compressed teeth are given off, they are subequal and with a small notch at their summits. Length of spicule ·043 mm., of the larger end ·013 mm., width of large end from apex to apex of lateral teeth ·035 mm., greatest width of shaft ·02 mm., width across teeth at small end ·015 mm. In general form this spicule resembles the flesh-spicules of *Cladorhiza*, Sars, and it probably represents a new species, which may be termed *C. Haasti*, in memory of the late Sir J. v. Haast, to whom we are indebted for a supply of the Oamaru material. This form approaches nearest to the flesh-spicules of *C. tridentata*, Ridley and Dendy (Chall. Rep. vol. xx. p. 95, pl. xxi. figs. 20 *a*, *b*, *c*), but it is little more than half the size, the alæ are more tapering, and the larger tubercle is pointed. The recent species is from diatom ooze, near the Crozet Islands, at a depth of 1600 fathoms.

The recent species of *Cladorhiza* are distinctively deep-water forms, ranging in depth to 3000 fathoms; the species referred to above are from the Crozet Islands and from the North-east of New Zealand respectively. The skeletal spicules in the existing species are acuates and pin-shaped, and corresponding forms are likewise present in the Oamaru deposit.

Anchorate Flesh-Spicules of Chondrocladia, *Wyv. Thomson.*

Chondrocladia (a).—Pl. X. fig. 31. Equianchorate with an elongated curved shaft of nearly equal thickness throughout as seen laterally. There are at least three short, divergent, acutely-pointed teeth at either end. Length of spicule ·058 mm., of teeth ·007 mm., thickness of shaft ·0041 mm. Viewed laterally this form has the same character as the equianchorates in some of the 'Challenger' species of *Chondrocladia*, e. g. *C. crinita*, Ridley and Dendy (Chall. Rep. vol. xx. p. 101, pl. xxi. fig. 17 *a*), from N. of New Guinea, depth 2000 faths.; but it is considerably smaller than the recent spicules.

Chondrocladia (b).—Pl. X. fig. 32. Equianchorate with nearly straight even shaft slightly swollen at the ends, and with three short conical teeth extending from either end nearly at right angles to the shaft. In the small size and simple character of the teeth this form resembles the normal flesh-spicules of recent species of *Chondrocladia*, but it does not approach very closely to any known form. Length of spicule ·053 mm., of the teeth ·005 mm., thickness of shaft ·005 mm. The cast of an apparently allied form is figured by Rüst from the Jurassic strata of Ilsede, Hanover (Pal., Bd. xxxi. pl. xx. fig. 10).

Chondrocladia (c).—Pl. X. fig. 33. Equianchorate with slender, elongate, curved shaft, slightly alate near the end, and slender acutely-pointed teeth, curved and slightly directed outwards. There are at least three of these teeth at either end. Length of spicule ·045 mm., of teeth ·01 mm., thickness of shaft ·0016 mm. Spicules of similar character but somewhat larger, and with more teeth, are figured by Ridley and Dendy in *Chondrocladia concrescens*, Osc. Sch. (Chall. Rep. vol. xx. p. 100, pl. xxi. fig. 12), from the North Pacific at a depth of 2900 fathoms.

Chondrocladia (d).—Pl. X. fig. 34. Equianchorate (?) with curved shaft, though straight in front view, and with six or seven small curved teeth at the upper end, whilst at the lower only four are shown. Length of spicule ·046 mm., of teeth ·0058 mm., thickness of shaft ·0041 mm.

Chondrocladia (e).—Pl. X. fig. 37. Equianchorate (?) with curved shaft, slightly expanded at either end, and constricted in the middle; at each end four stout incurved teeth are shown, with a central falx or tubercle. Two of the teeth at each end are apparently in advance of the others, they are connected together by a siliceous membrane. Traces of other teeth can be seen by focussing, but whether the full number at either end is 5 or 7 is uncertain. Length of spicule ·08 mm., of teeth ·023 mm., width across teeth ·026 mm., thickness of shaft ·011 mm. The front aspect of this spicule corresponds closely with that of the equianchorate in *Chondrocladia virgata*, Wyv. Thoms., as figured by Mr. Carter (Ann. & Mag. N. H. s. 4, vol. xiv. 1874, p. 217, pl. xiv. fig. 21 *b*). Viewed on end the recent spicule has 7 teeth or claws at each end, but in front only four of these are visible. The fossil spicule is larger and the shaft less expanded than in the type forms of the recent species.

Bipocillate Flesh-Spicule of Iophon, Gray.

Iophon hybridus, n. sp.—Pl. X. fig. 44. Spicule with a short, apparently straight shaft having three subpalmate teeth at one end and a shallow cup-like base at the other. The lateral teeth of the upper end are evenly curved, with slightly revert margins, blunted inferiorly. The anterior tooth projects apparently directly outwards, the tubercle at its base is slightly elevated above the curve of the lateral teeth. The margins of the cup-like end of the spicule are thickened or inverted and elevated at the sides, so as nearly to meet the lateral teeth of the upper end. The shaft has an axial canal which is slightly inflated at the upper end. Length of spicule ·023 mm., width across teeth ·02 mm., thickness of shaft ·004 mm. This spicule is evidently of the same character as the bipocilli spicules of *Iophon*, Gray, as figured by Bowerbank (Mon. Brit. Spong. vol. i. p. 248, pl. v. figs. 123–127) and by Ridley and Dendy (Chall. Rep. vol. xx. pl. xvii. figs. 3, 9), but it shows a nearer relation to the normal anchorate spicule than the bipocilli of recent sponges of this genus. Ridley and Dendy consider the bipocilli as much modified inequianchorate spicules. Recent spicules of this type are much smaller than the present fossil, which clearly belongs to a new species and may be designated *Iophon hybridus*.

The skeletal spicules of *Iophon* are acuates and tibiellas, not very dissimilar from those of *Melonanchora*, and several recent species of the genus are found in the Australian and South Seas.

Anchorate Flesh-Spicules of Guitarra, *Carter.*

Guitarra Carteri, n. sp.—Pl. XI. figs. 1, 2, 3. Spicules of hour-glass form, consisting of two equal subcircular plates in contact with each other. The shaft is not often distinguishable; it is, as shown in fig. 3, straight and of an even thickness. Usually it is so amalgamated with the lateral portions of the circular plates that it cannot be recognized. The plates bounding it represent the lateral palms of the spicule. The central tubercles are circular in outline and prominent; they are connected by the axial canal, which appears as a fine thread between them (fig. 2). The anterior palms are circular plates of a similar form and size to the lateral plates, and as they meet in the central line they cannot be distinguished from these latter when the front of the spicule is exposed to view. The margin of the lateral palms is transversely striated, and the outer surface of the anterior palm has also on both sides a series of fine transverse markings which reach nearly to the centre (fig. 1). Length of spicules from ·09 to ·115 mm., width ·05 mm. These spicules are much larger than those of the only known recent species, and further different in having the anterior palms meeting in the centre. As indicating a new species they may be named *Guitarra Carteri*, in honour of Mr. H. J. Carter, F.R.S.

Guitarra intermedia, n. sp.—Pl. XI. figs. 4–7. Spicules of hour-glass form, but having the lateral palms at either end connected by a constricted interspace (fig. 4), the tubercles distinct and connected by the axial canal. The anterior palm is ovoid in form with definite incurved margins; it extends either obliquely to the shaft (fig. 5) or nearly parallel with it, but the palms do not meet as in the preceding form. The outer surface of the lateral palms is minutely spined and the margins are striated. These spicules range in length from ·065 to ·115 mm., and they are about ·045 mm. in width. An apparently young form (fig. 7), which is magnified on the scale of 600 diameters, is only ·04 mm. in length. In fig. 4 the front surface of a spicule is shown in which the anterior palms have been broken away; fig. 5 is an oblique view of another form showing clearly the margins of the palms; fig. 6 is a lateral view in which the front margins of the anterior palms appear as if hooked; whilst fig. 7 is an oblique view of a small form in which the axial canal of the shaft appears to be supplemented by canals in the anterior palms. These spicules approach nearer to those of the recent species *Guitarra fimbriata*, but the mature forms appear to be distinctly larger, and they may be considered as indicating a new species, *G. intermedia*.

These peculiar forms of anchorate spicule were first discovered by Mr. Carter in a sponge from the depths of the North Atlantic dredged up by the 'Porcupine' Expedition (Ann. & Mag. Nat. Hist. s. 4, vol. xiv. 1874, p. 210, pl. xiii. figs. 2–5, pl. xv. fig. 34), and they were subsequently found by Osc. Schmidt in a sponge from the Gulf of Mexico, at the depth of 95 fathoms (Mexico Spong. 3 Th. p. 84, t. ix. fig. 7). They have not previously been met with in the fossil state. Mr. Carter's explanation of the hourglass form as resulting from flattened lateral palms connected together above and below is quite borne out by our fossils, for, as already mentioned, in one instance (fig. 3) the shaft proper of the spicule is shown distinct from the lateral wings, and this shaft has the axial canal extending through it. The only skeletal spicules in the recent *Guitarra fimbriata* are straight acerates without any distinctive features.

Anchorate Flesh-Spicules of Pseudohalichondria, *Carter*.

The spicules described below belong to a peculiar type of anchorate characterized more especially by an unequally expanded shaft and the presence of numerous spines and protuberances both on the shaft and the teeth or palms. In some instances the spines are so developed that the anchorate character of the spicule is masked and it has the appearance of a spinispirular flesh-spicule. As a rule the shafts in these spicules are strongly curved, so that viewed laterally they are G-shaped. The only recent sponge with anchorate flesh-spicules at all comparable with these fossils is *Pseudohalichondria clavilobata*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. xviii. 1886, p. 454, pl. x. figs. 8 *a*, *d*), from the Australian seas, and they are threfore placed in the same genus.

Pseudohalichondria deformis, n.sp.—Pl. XI. figs. 8, 9. Spicules equianchorate, subpalmate, with robust, curved, inequally expanded shaft with projecting knobs and protuberances; lateral palms tongue-shaped, uneven, irregularly spined; anterior tubercles distinct, palms tongue-shaped. Length of spicule ·031 mm., of palms ·013 mm., width across palms ·02 mm., extreme width of shaft ·015 mm. Figs. 8 and 9 represent the lateral and front views respectively of the same spicule. It appears to be distinct from any spicule yet described, and may be termed provisionally *Pseudohalichondria deformis.*

Pseudohalichondria (a).—Pl. XI. fig. 10. Equianchorate spicule with irregularly expanded shaft armed with spines; the ends also are armed with prominent conical spines alike on the anterior and lateral teeth. Length of spicule ·033 mm., of the ends ·011 mm., thickness of shaft ·016 mm. Only a front view of this spicule has been recognized.

Pseudohalichondria (b).—Pl. XI. figs. 11, 14. Spicules with strongly curved shafts armed on the exterior or convex surface with stout conical spines. The anterior and lateral teeth at both ends are also strongly spined. Length of spicule ·02 to ·027 mm., thickness of shaft ·0087 mm. Only the lateral view of this form is known.

Pseudohalichondria Oamaruensis, n. sp.—Pl. XI. figs. 12, 13. Equianchorate spicule with strongly curved shaft, widest in the middle and spined; at either end of the spicule a semicircular notched border and a very prominent curved anterior tooth. Length of spicule ·0267 mm., of the ends ·0083 mm., width 015 mm., greatest width of shaft ·013 mm. Fig. 12 is an oblique, and fig. 13 a lateral view of the same spicule. It is a distinctly new form, and may be termed *Pseudohalichondria Oamaruensis.*

Pl. X. fig. 45. Equianchorate spicule having a shaft with an elbow-like curve and armed with stout occasional spines. Teeth short, incurved. Length of spicule ·043 mm., of the teeth ·01 mm., thickness of shaft ·0086 mm. Only a lateral view known.

Sceptrella or Chessman Flesh-Spicules of Latrunculia, *Bocage.*

These spicules, for which the name of "Sceptrella" was proposed by Mr. Carter (Ann. & Mag. Nat. Hist. s. 5, vol. iii. 1879, p. 358), consist of an upright cylindrical shaft or axis, furnished with stout spines, spined plates, discs, or drums, usually arranged in whorls at irregular intervals, whilst spines either single or in groups radiate from the upper and lower ends of the shaft. The spines themselves not infrequently are provided with smaller secondary spines. In recent sponges of this genus these flesh-spicules are usually thickly set over the surface, forming a dermal crust or layer, as well as scattered through the soft tissues of the sponge. The skeletal spicules of *Latrunculia* are simple forms of acerates and acuates.

Previous to the 'Challenger' Expedition about four or five species with "Sceptrella" spicules had been described, and the 'Challenger' material yielded four other species. In the Oamaru deposit the sceptrellas are very numerous, and they present an extraordinary variety of form resulting from different modifications of the spined whorls, so that if, judging from the recent sponges, only one or at most two of these modifications are present in a species, there must be a greater number of species present in the Oamaru material than have hitherto been found living at the present time. As fossil, Sceptrella spicules were first noticed in the Jurassic strata of Ilsede, Hanover, by Dr. Rüst ('Palæontographica,' Bd. xxxi. p. 321, pl. xx. figs. 35, 36).

Latrunculia (a).—Pl. XI. fig. 15. Sceptrella with short stout shaft terminating at either end with a central prominent conical spine, the base of which is surrounded by a ring of obliquely directed spines; at equal distances on the shaft are two whorls of similar spines projecting directly outwards. All the spines are armed with secondary spines. Length of spicules (including spines) ·066 mm., width across whorls ·033 mm., thickness of shaft ·016 mm. This form is very abundant. It somewhat resembles the sceptrella of *Latrunculia corticata*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. iii. p. 298, pl. xxvii. fig. 4 *a*), but it is twice as large and has the terminal spine in addition. Similar but larger forms are present detached in dredgings by H.M.S. 'Egeria' from off the S.W. coast of Australia at depths of 3000 fathoms. A very similar form is also figured by Dr. Rüst from the Jurassic radiolarian marls of Ilsede, Hanover ('Palæontographica,' Bd. xxxi. p. 321, pl. xx. fig. 35).

Latrunculia (b).—Pl. XI. fig. 16. Sceptrella with short thick shaft armed with short conical spines at the base, above this are two whorls of stout spines apparently rising from the margins of discs, a third whorl is near the summit, and the apex is formed by a group of upwardly directed spines. Length of spicule ·05 mm., width across whorls ·036 mm., thickness of shaft ·0016 mm. This spicule is also of the same type as the flesh-spicules in *L. corticata*, Carter, and in *Sceptrella regalis*, Osc. Sch., but differs from both these in size and in the close arrangement of the whorls.

Latrunculia (c).—Pl. XI. fig. 17. Sceptrella with stout shaft having obliquely directed spines at its base; in the middle of the shaft a whorl of spines, apparently grouped in fours, and another similarly formed whorl near the summit. The apex consists of a central spine surrounded by smaller ones. Length of spicule ·083 mm., extreme width of whorls ·056 mm., thickness of shaft ·016 mm.

Latrunculia (d).—Pl. XI. fig. 18. Sceptrella with oblique furcate spines at the base, a median whorl of simple and furcate spines, and a summit of stout horizontal or oblique spines. The apex consists of a group of slender acute spines. Length of spicule ·04 mm., width across whorls ·023 mm., thickness of shaft ·007 mm.

Latrunculia (e).—Pl. XI. fig. 19. Sceptrella having an expanded base of obliquely directed acute spines, a median whorl of horizontal spines of unequal sizes, and a summit whorl of trifurcate spines. At the apex are minutely dentate crests and spines. Length ·031 mm., width of central whorl ·027 mm., thickness of shaft ·0083 mm. This form is of a similar character to the preceding (fig. 18), but it is shorter and more compact.

Latrunculia (f).—Pl. XI. fig. 20. Base of shaft expanded, with minute divergent spines, central whorl of horizontal spines, summit expanded and an apex of upright laminæ with spined margins. Length of spicule ·036 mm., width of whorl ·016 mm., thickness of shaft ·005 mm.

Latrunculia (g).—Pl. XI. fig. 21. Sceptrella with expanded base armed with small simple spines; a median whorl of horizontal spined processes, and a similar but narrower summit whorl. The apex of the shaft is obtusely rounded, with a crest of minute spines. Length of spicule ·046 mm., width of median whorl ·031 mm., thickness of shaft ·011 mm.

Latrunculia (h).—Pl. XI. fig. 22. Base of shaft with strongly divergent simple spines, a median whorl of stout horizontally disposed spines, the summit and apex consists of a group of facetted and minutely spined protuberances. Length of spicule ·056 mm., width of median whorl ·048 mm., thickness of shaft ·013 mm.

Latrunculia (i).—Pl. XI. fig. 23. Sceptrella with base of stout divergent spines and a median whorl of horizontal spines as in the preceding form; above is a whorl of vertical laminæ with spined or dentate margins; the apex is conical, spined, with a terminal spire. Length of spicule ·058 mm., width of median whorl ·04 mm., thickness of shaft ·013 mm.

The seven forms described above (Pl. XI. figs. 17–23) are all modifications of a common type which has an expanded base of divergent spines, a median whorl of horizontal spines, and an upper or summit whorl of spines, whilst the apex is pointed or obtusely spined, or of upright laminæ. These spicules are distinct in these details from the sceptrellas of any recent species of *Latrunculia.*

Latrunculia Oamaruensis, n.sp.—Pl. XI. fig. 34. Sceptrella with stout, elongate, subfusiform shaft; at the base are three or four whorls of minute spines separated by short interspaces, separated from these by a smooth interval is a whorl of conical horizontally disposed spines or processes, followed above by five other whorls at irregular intervals. At the upper end of the shaft is a whorl of curved spines or plates, and the apex is formed by a stout vertical spine. The spines or processes of the whorls are armed with secondary spines. Length of spicule ·206 mm., greatest width of whorls ·043 mm., thickness of shaft ·016 mm.

Pl. XI. fig. 35. Sceptrella of nearly the same character as the preceding, but the shaft is curved, the spined whorls are much less regular and there are intermediate single spines, whilst the upper end consists of a shallow cup-shaped expansion with a group of spines at the apex, some of which have minute globular heads.

This and the preceding form greatly exceed in size the sceptrellas in any recent species; they probably belong to the same species, which may be provisionally named *Latrunculia Oamaruensis.*

Latrunculia (k).—Pl. XI. fig. 36. Sceptrella with straight, robust, subfusiform shaft, the base furnished with three whorls of minute spines; above these are five whorls of stout conical processes, secondarily spined; an upper whorl of curved spines or plate-like hooks, and at the apex several projecting spines. Length of spicule ·133 mm., width across whorls ·04 mm., thickness of shaft ·013 mm. In character this spicule resembles the preceding, but it is much shorter.

Latrunculia (l).—Pl. XI. fig. 37. Sceptrella with stout subcylindrical shaft having four or five whorls of minute spines at the base, succeeded above by three whorls of spines or processes.

In the lower of these the spines are directed obliquely downwards, whilst in the two higher whorls they curve towards the apex. The spines in these whorls are thickly set with secondary spines. At the upper end is a whorl of upwardly curved spines, and a single prominent spine forms the apex. Length of spicule ·093 mm., greatest width of whorls ·043 mm., thickness of shaft ·013 mm.

Latrunculia (m).—Pl. XI. fig. 38. Shaft subcylindrical, with two whorls of small spines at the base, succeeded above by an inverted saucer-like disc with dentated margin, and a similar but smaller disc with the concavity upwards. At the summit is a whorl of curved teeth or spines. Length of spicule ·043 mm., width of lower disc ·027 mm., thickness of shaft ·0075 mm.

Latrunculia (n).—Pl. XI. figs. 39, 40. Sceptrella with slender cylindrical shaft having at the base two or three whorls of minute spines, and in the middle portion of the shaft two whorls of lobate plates with spined margins. At the summit a whorl of curved blunted spines. Fig. 11 shows, on the scale of 600 diameters, one of the lobate whorls as seen from above, the section of the circular shaft with the axial canal can be distinguished. Length of spicule ·075 mm., width of whorl ·033 mm., thickness of shaft ·006 mm.

The six forms described above (Pl. XI. figs. 34–39) are modifications of a common plan. Recent flesh-spicules of this type are present in the following species :—*Latrunculia cratera*, Bocage (Journ. d. Sci. Lisbonne, no. 4, 1869, pl. xi. fig. 2) ; *L. Bocagei*, Ridley & Dendy, *L. brevis*, Ridley & Dendy (Chall. Rep. vol. xx. pp. 237, 238, pl. xlv. figs. 8 *a*, 10 *a*) ; *L. purpurea*, Carter (Ann. & Mag. Nat. Hist. ser. 5, vol. vii. 1881, p. 380, pl. xviii. figs. 5 *b*, *c*) ; and also in detached spicules described by Mr. Carter from deep water off the Seychelles (Ann. & Mag. Nat. Hist. ser. 5, vol. iii. 1879, p. 358, pl. xxix. figs. 14, 17) ; and they differ from the fossil forms only in the details of size and the disposition of the spines, &c.

Latrunculia (o).—Pl. XI. fig. 24. Sceptrella with base of shaft expanded, with projecting simple spines ; succeeded above by a nearly median whorl of depressed spines and an upper whorl of curved spines. The apex consists of a group of thin vertical laminæ with their edges outwards. Length of spicule ·04 mm., width of lower whorl ·016 mm., thickness of shaft ·006 mm.

Latrunculia (p).—Pl. XI. fig. 25. Spicule with toothed base, an inverted lower disc-like whorl with dentate margins, and a similar but upright summit whorl. These whorls are connected so as to form a drum with constricted centre. The apex is conical, terminated by a single spine. Length of spicule ·034 mm., width of whorls ·018 mm., thickness of shaft ·006 mm.

Pl. XI. fig. 26. Sceptrella similar to the preceding, but with a tiara-like apex of three curved spines.

Latrunculia (q).—Pl. XI. fig. 27. Small sceptrella with base of projecting spines, a thick inverted disc-shaped lower whorl, with spined surface and margins; at the upper end a cup-shaped whorl with a dome-shaped, minutely-spined apex. Length of spicule ·02 mm., width of lower whorl ·015 mm., thickness of shaft ·005 mm.

Latrunculia (r).—Pl. XI. fig. 28. Shaft of spicule with an expanded dentate base, a median disc with apparently smooth margins, summit cup-like with a semi-globate apex with blunted spines. Length of spicule ·036 mm., width of lower whorl ·026 mm., of shaft ·011 mm.

Latrunculia (s).—Pl. XI. fig. 29. Sceptrella with expanded base of divergent spines, a short robust shaft, and at the top a group of laminæ having a plume-like arrangement. Length of spicule ·026 mm., width of base ·018 mm., thickness of shaft ·007 mm.

Pl. XI. fig. 31. Spicule of the same character as the preceding, but the spines of the base are larger and the laminæ at the apex are vertical. Length of spicule ·035 mm.

Pl. XI. fig. 30. Sceptrella with an expanded base of furcate, claw-like spines, a short cylindrical shaft with a group of spreading furcate spines at the summit. Length of spicule ·023 mm., width ·016 mm., thickness of shaft ·0047 mm.

This and the two preceding forms (figs. 29, 30, 31) differ from what may be considered the normal type of "sceptrella" in not having a median whorl, and the spicule is reduced to an expanded spined base and divergent laminæ or spines at the summit of a short shaft.

Latrunculia obtusa, n. sp.—Pl. XI. fig. 32. Sceptrella with subcylindrical, obtusely ended shaft with two circular discoid whorls in the upper half, their margins inflated. The summit of the shaft is obtuse conical. The entire surface of shaft and whorls set with minute spines. Length of spicule ·053 mm., width of whorl ·023 mm., thickness of shaft ·01 mm. A detached recent spicule from near the Seychelles has been figured by Mr. Carter which has considerable resemblance to this fossil (Ann. & Mag. Nat. Hist. s. 5, vol. iii. pl. xxix. fig. 20). Spicules of the same type but considerably smaller also occur in *Latrunculia* (?) *acerata*, Ridley and Dendy (Chall. Rep. vol. xx. p. 239, pl. xxix. fig. 3 *b*). The present fossil indicates a distinct species, which may be termed *Latrunculia obtusa*.

Latrunculia (t).—Pl. XI. fig. 33. Shaft cylindrical, with a slight circular expansion at the base; slightly above the middle a thin-edged circular disk, and a similar but slightly smaller disk at the summit of the spicule. The surface appears to be smooth throughout. An axial canal extends through the shaft. Length of spicule ·026 mm., width of whorl ·17 mm., thickness of shaft ·005 mm. This spicule is of the same character as the preceding, but the upper disc is terminal.

Latrunculia (u).—Pl. XI. fig. 45. Spicule with stout short shaft, angular and pointed at the lower end, and at the summit a dome-shaped apex. In the upper portion are two whorls of rounded or ovate nodes, whilst at the lower there are two pairs of elongate ovate processes extending horizontally from the shaft. Length of spicule ·033 mm., greatest width ·028 mm. An axial canal traverses the shaft, terminating above with a small inflation. This peculiar form varies considerably from the normal flesh-spicules of *Latrunculia*, but it seems more nearly allied to these than to the spicules of *Thoosa* described below.

Flask-shaped Flesh-Spicules of Latrunculia (?), *Bocage.*

Latrunculia (v).—Pl. XII. fig. 1. Spicule with a depressed globular body, a short neck, and a spined summit. The globate portion is studded with stout short conical spines, obtusely pointed and projecting directly outwards, the neck is without spines, whilst the summit is slightly inflated and covered with somewhat claw-shaped spines. At the apex is a single vertical spine. Length of spicule ·043 mm., thickness of body ·035 mm.

Pl. XII. fig. 2. Spicule with subangular body with wide base. The upper portion conical. The body is armed with long, stout, obtuse spines, near the summit is an inflated portion covered with hooked spines, and at the apex is a prominent vertical spine. An axial canal extends from the apex to a little below the centre of the body, where it terminates in a slight inflation. Length of spicule ·037 mm., greatest thickness ·029.

In no recent sponge, so far as we are aware, have any flesh-spicules been described which resemble at all closely these peculiar forms. The presence of a simple axial canal indicates that they belong to Monactinellid sponges, and as there is a certain correspondence in form to some of the sceptrellas of *Latrunculia*, it seems preferable to place them provisionally under this genus. It is highly probable that, like the sceptrellas, they formed a kind of surface-armour on the dermal layer of the sponge, having the spined apices projecting outwards.

Flesh-Spicules of Thoosa, *Hancock.*

Thoosa Hancocki, n. sp.—Pl. XI. fig. 41. Spicule stout, cylindrical, barrel-shaped, with a whorl of six subspherical tubercles at the top and bottom, and a single tubercle supported on a short stem at either end. The tubercles of the body are sessile, their surfaces are covered with minute spines or pustules. An axial canal is shown as a thin rod in the centre of the body or shaft. Length of spicule ·022 mm., width ·015 mm., thickness of tubercles ·0045 mm.

Pl. XI. fig. 42. Spicule of the same character as the preceding, but smaller and less robust. Length of spicule ·018 mm., width ·013 mm., thickness of tubercles ·003 mm. This and the preceding form are precisely similar in character to the so-called mulberry flesh-spicules in the tropical boring sponges *Thoosa cactoides* and *T. bulbosa*, Hancock (Ann. & Mag. Nat. Hist. vol. iii. 1849, pp. 330, 346, pl. xii. fig. 10 *a*), and also to those of *T. socialis*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. vi. 1880, p. 56, pl. v. fig. 23 *a*), from the Gulf of Manaar, but they are smaller generally and the tubercles less developed, whilst the shafts are more robust. The recent spicules form a dense dermal layer to the sponges and appear to be the only spicules present, though in *T. socialis* Mr. Carter describes some minute circular discs as well. As the fossils represent a distinct species, it may be named *Thoosa Hancocki*.

Pl. XI. fig. 43. Spicule with short barrel-shaped shaft and two whorls of tubercles, four apparently in each ; the tubercles are supported on short stalks, similar to those of the terminal tubercles at either end. Length of spicule ·024 mm., width

·016 mm., thickness of tubercles ·0025 mm. This form is perhaps only a variety of the preceding.

Thoosa (a).—Pl. XII. fig. 3. Spicule with short barrel-shaped body, having above and below three curved obtuse processes slightly furcate at the extremity which project outwards. At either end of the body is a similar blunt process with terminal spines, that at one end is slightly larger than the opposite one. Length of spicule ·03 mm., greatest width ·02 mm. In its general form this spicule resembles the normal flesh-spicules of *Thoosa*, but the tubercles are replaced by furcate and spined processes.

Sceptrelliform Flesh-Spicules of Alectona, *Carter*.

Pl. XI. fig. 44. Spicule with straight subfusiform shaft, obtuse at both ends, an expanded central portion with two whorls of spherical bead-like bodies supported on short stalks, about eight or nine in each whorl. The surface of the shaft is minutely spined, and an axial canal extends through it opening at both ends. Length of spicule ·042 mm., width across whorls ·011 mm., thickness of shaft ·005 mm. This form corresponds very closely with the flesh-spicule of *Alectona* (*Corticium*) *Wallichi*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. iii. 1879, p. 353, pl. xxix. fig. 8).

Spirular Flesh-Spicules of Spirastrella, *Osc. Schmidt*.

Spirastrella (a).—Pl. XII. figs. 4, 5. Spicules with a short sinuous shaft from which large conical, obtusely pointed spines project in different directions. Length of spicule ·03 to ·033 mm., thickness ·011 to ·016 mm. These spicules so closely resemble in form and size the flesh-spicules of *Spirastrella cunctatrix*, Osc. Schm. (Algier. Spong. p. 17, t. iii. fig. 8), that they might be considered to belong to this species, which is widely distributed, Mr. Carter having recorded it from the Australian Seas (Ann. & Mag. Nat. Hist. s. 5, vol. xvii. 1886, p. 113). They also occur in the 'Egeria' dredgings off the S.W. coast of Australia at a depth of 2479 fathoms. The skeletal spicules of the recent sponge are either pin-shaped or acuates, and of these there are great numbers in the Oamaru material. Fossil forms closely similar are figured by Dr. Rüst from the Jurassic strata of Ilsede, Hanover ('Palæontographica,' Bd. xxxi. pl. xx. figs. 37, 38).

Spirastrella (b).—Pl. XII. fig. 6. Spirule having a single curve, the shaft is slightly swollen at the ends, which are thickly set with spines, at the bend of the curve is another group of spines, whilst the intermediate portion of the shaft is smooth. Length of spicule ·025 mm., thickness (including spines) ·015 mm.

Spirastrella (c).—Pl. XII. fig. 7. Spirule with short and strongly curved axis and stout conical spines somewhat thickly set over the spicule and more particularly at the ends, so that its appearance is rather that of a globate. Length of spicule ·025 mm., thickness ·02 mm. This spicule resembles the spirule of *Spirastrella transitoria*, Ridley ('Alert' Rep. p. 623, pl. liv. fig. *q'*), but it is considerably larger.

Spirular Flesh-Spicules of Pronax, *Gray* (=Cliona, *Hancock, pars*).

Pronax (a).—Pl. XII. figs. 8, 8 *a*. Spicules cylindrical, smooth, truncate at the ends, consisting of four or five inequal twists. Length ·04 to ·046 mm., thickness ·0033 mm. These spicules resemble the forms discovered by Hancock in several species of boring sponges, referred by him to *Cliona*, but subsequently placed by Gray in the genera *Pronax* and *Pione* (Proc. Zool. Soc. 1868, pp. 525–6). They approach nearest in outline those of *Cliona gracilis*, Hancock (Ann. & Mag. Nat. Hist. s. 3, vol. xix. 1867, p. 238, pl. vii. fig. 4). Mr. Carter has figured a similar but larger form in *Cliona abyssorum* (Ann. & Mag. Nat. Hist. s. 4, vol. xiv. 1874, p. 249, pl. xiv. fig. 33), from the depths of the Atlantic.

Pronax (b).—Pl. XII. fig. 9. Spirule elongate, cylindrical, truncate at the ends, having about six bends or twists; at each bend or curve there are three or four slender spines projecting outwards, the rest of the spicule appears to be smooth. This form closely resembles the spicules of *Pronax* (*Cliona*) *lobata*, Hancock, sp. (Ann. & Mag. N. H. s. 3, vol. xix. 1867, p. 239, pl. vii. fig. 6). Similar flesh-spicules are also figured by Ridley in *Spirastrella vagabunda* and *S. congenera* ('Alert' Rep. p. 468, pl. xliii. figs. *d'*, *e'*), and by Mr. Carter in *Rhaphidistia spectabilis* (Ann. & Mag. Nat. Hist. s. 5, vol. iii. 1879, p. 300, pl. xxvi. fig. 14 *a*).

Summary of the Genera and Species of Monactinellid Sponges represented in the Oamaru Deposit.

We give below a list of the genera, and an approximate estimate of the number of species in each, which appear to be represented by the detached spicules referred to in detail in the preceding pages. With one or two exceptions the genera are arranged according to the classification of Ridley and Dendy in their 'Challenger' Report and of Vosmaer in the Monograph on the Porifera in Bronn's 'Klass. u. Ordn. des Thierreichs.'

Division MONACTINELLIDÆ, *Zittel.*

Group HALICHONDRINA, *Vosmaer.*

Family HOMORRHAPHIDÆ, *Ridley & Dendy.*

No. of Species.	Genus.	Flesh-Spicules.		Skeleton-Spicules.
(?)	*Reniera* (?), Nardo			S.S.
(?)	*Chalina* (?), Grant			S.S.

Family DESMACIDONIDÆ.

No. of Species.	Genus.	Flesh-Spicules.		Skeleton-Spicules.
2	*Forcepia*, Carter	F.S.	&	S.S.
1	*Acarnus*, Gray	F.S.	&	S.S.
3	*Hamacantha*, Gray	F.S.	&	S.S.
10	*Esperella*, Vosmaer (=*Esperia*, Nardo).	F.S.	&	S.S.
4	*Esperiopsis*, Carter	F.S.	&	S.S.
1	*Cladorhiza*, Sars	F.S.	&	S.S.
4	*Chondrocladia*, Wyv. Thomson	F.S.	&	S.S.
12	*Desmacidon*, Bowerbank	F.S.	&	S.S.
	Myxilla, Osc. Schmidt	F.S.	&	S.S.
1	*Iophon*, Gray	F.S.	&	S.S.
1	*Amphilectus*, Vosmaer	F.S.	&	S.S.
2	*Guitarra*, Carter	F.S.	&	S.S.
1	*Melonanchora*, Carter	F.S.	&	S.S.
4	*Pseudohalichondria*, Carter	F.S.	&	S.S.
2	*Plocamia*, Osc. Schmidt			S.S.

Family AXINELLIDÆ, *Ridley & Dendy.*

No. of Species.	Genus.	Flesh-Spicules.		Skeleton-Spicules.
(?)	*Axinella* (?), Osc. Schmidt			S.S.
(?)	*Hymerhaphia* (?), Bowerbank........			S.S.

Group CLAVULINA, *Vosmaer.*

Family SPIRASTRELLIDÆ, *Ridley & Dendy.*

No. of Species.	Genus.	Flesh-Spicules.		Skeleton-Spicules.
2	*Spirastrella*, Osc. Schmidt	F.S.	&	S.S.
2	*Pronax*, Gray......................	F.S.	&	S.S.

Family LATRUNCULIDÆ, nov.

15	*Latrunculia*, Bocage................	F.S.	&	S.S.
2	*Thoosa*, Hancock	F.S.	&	S.S.
1	*Alectona*, Carter	F.S.	&	S.S.
70				

In this list 24 genera are enumerated and 70 species. Four genera are considered doubtful, and no species are placed under them, since they are only represented by skeleton-spicules. Of the other genera, distinctive flesh-spicules have been recognized in all, with the exception of *Plocamia*, Osc. Sch., and in this genus the dumb-bell forms of skeleton-spicules are sufficiently characteristic. In estimating the number of species we have taken into consideration the fact that in recent sponges of this group there are many characterized by only a single distinctive form of flesh-spicule, whilst in others there are two or occasionally three distinctive forms.

It will be seen that the genera most numerously represented are *Esperella* with 10 species, *Desmacidon* and *Myxilla* with 12 species between them, and *Latrunculia* with 15 species. We venture to consider this latter genus as the type of a new family, distinguished by sceptrelliform flesh-spicules. Hitherto, the genus has been placed in the *Spirastrellidæ* by Ridley and Dendy, but there does not appear to be any form-relationship between the spiral flesh-spicules of this last-named family and the sceptrellas of *Latrunculia* and its allied genera *Thoosa* and *Alectona*. By Vosmaer *Latrunculia*, or its synonym *Sceptrella*, was placed in the *Desmacidonidæ* on the supposition that it possessed an anchorate flesh-spicule, but, as already mentioned, this anchorate is in all probability adventitious.

The significance of so many species of Monactinellid sponges from this single fossil deposit will appear the greater from the fact that the 'Challenger' Expedition only obtained 16 recent species of this group of sponges from the entire geographical area of the Southern Pacific, in which New Zealand is placed, whilst from the Indo-Australian area, which proved the most prolific in species of this group, only 74 species were obtained (Chall. Rep. vol. xx. p. 259). From the vicinity of New Zealand itself not a single species of Monactinellid was obtained by the 'Challenger.'

II. TETRACTINELLIDÆ, *Marshall.*

Family Corticidæ, *Vosmaer.*

Candelabra Spicules of Corticium, *Osc. Schmidt.*

Corticium (a).—Pl. XII. fig. 10. Candelabrum with basal portion of 8 or 9 stout conical rays and the crown or summit of 7 or 8 unequal, stout, straight or curved tapering rays, with slightly inflated summits. The exterior or convex margin of these rays is spined or tuberculate. Length of spicule ·05 mm., width across ·05 mm.; length of basal rays ·018 mm., width ·01 mm.; length of head-rays ·02 mm.

Pl. XII. fig. 11. Candelabrum with base of stout conical rays about 9 in number, the summit of four unequal, slightly curved rays with slightly inflated heads, their outer margins spined. Length of spicule ·035 mm., width the same; basal rays, length ·015 mm., thickness ·005 mm.; summit-rays, length ·015 mm., thickness ·0033 mm. This is a smaller spicule than the preceding and it has fewer summit-rays, but it is probable that both forms may belong to the same species. These spicules are much stouter than those of the recent *Corticium candelabrum*, Osc. Schmidt, and the summit-rays are inflated instead of pointed (Adriat. Spongien. p. 42, pl. iii. fig. 25).

Corticium (b).—Pl. XII. fig. 12. Candelabrum with about 15 basal rays and 10 or more in the summit or crown. These latter are slightly incurved, claw-shaped, and terminate in an obtuse point, their convex margins are spined. The basal rays in this form are also set over with small spines. Length of spicule ·045 mm., extreme width ·038 mm.; length of basal rays ·018 mm., thickness ·005 mm.; summit-rays, length ·01 mm., thickness ·006 mm. The pointed termination of the head-rays and the spination of the basal rays indicate that this form belongs to a species distinct from the preceding. A detached spicule of similar form to the above occurs in the dredgings by the 'Egeria' off the S.W. of Australia at a depth of 2479 fathoms.

Pl. XII. fig. 13. Candelabrum with about eight basal rays and a crown of six short subequal claw-like rays, supported on a distinct neck or pedestal. The rays spined on their convex margins. The basal rays appear to be smooth. In some of the rays axial canals can be distinguished. Length of spicule ·031 mm., width of base ·03 mm.; length of basal rays ·013 mm., thickness ·006 mm.; summit-rays, length ·0067 mm., thickness ·0035 mm.

Pl. XII. fig. 13 *a*. Candelabrum with about 12 basal rays, apparently resulting from the quadripartite division of each of the three normal rays; the rays are either simple, slightly curved, and obtusely pointed, or slightly furcate at the extremities. The summit consists of four pointed smooth rays springing from a short pedestal. Length of spicule ·031 mm., extreme width ·035 mm., length of basal rays ·015 mm., thickness ·0046 mm. The summit-rays are of nearly the same size as the basal. Fig. 14 is of the same character, but smaller.

Pl. XII. fig. 15. Candelabrum with nine basal rays resulting from the trifurcation of the three normal rays, and about eight or nine summit-rays which are short, claw-shaped, and apparently smooth, rising from a short pedestal. Of nearly similar dimensions to fig. 13. It is probable that this form, with the three preceding, may belong to the same species, and with these the form represented by fig. 12 may be included, though it is larger and more distinctly spined. Of a similar type to these spicules may be mentioned the form described by Wisniowski (Kosmosu Roczn. xiv, zesz. vii.–viii. 1889, p. 9, pl. fig. 11) from the Jurassic strata near Cracow, but in this the summit-rays are reduced to three or four.

Corticium (c).—Pl. XII. fig. 16. Candelabrum in which each of the normal basal rays is divided into four stout conical rays, whilst the summit consists of four approximately straight, slightly divergent rays, which are sessile and slightly quadripartite at their ends, each division terminating in a small tubercle. Height of spicule ·027 mm., width ·031 mm. Summit-rays, length ·011 mm., thickness ·0033 mm. The summit-rays of this form are very different from the preceding, and it probably represents a distinct species.

Corticium (d).—Pl. XII. fig. 17. Candelabrum with the basal rays very unequally divided, resulting either in a simple slight furcation near their extremities or in a division into three conical rays, as in the preceding spicules. The summit is formed by three simple, slightly recurved rays on a short base. Height of spicule ·021 mm., width of base ·025 mm.; summit-rays, length ·006 mm., thickness ·0033 mm. In the simple character of the summit-rays and inequal division of the basal rays, this form agrees with the spicules of *Corticium versatile*, Osc. Sch. (Mexican Spong. p. 69, pl. ix. fig. 5), from St. Vincent, at a depth of 95 fathoms.

Corticium (e).—Pl. XII. fig. 18. Candelabrum in which the three basal rays are equal and simple, with an occasional spine here and there; the summit consists of three or four minute pointed rays and one or two spines. Length of basal rays ·031 mm. each, thickness ·006 mm. This form also corresponds in character with the spicules of *C. versatile*, Osc. Sch.

Pl. XII. fig. 19. Candelabrum with simple, elongate, pointed basal rays and a summit of about six divergent rays, which are slightly bi- and trifurcate at their extremities. Length of basal rays ·036 mm. each, thickness ·0053 mm.; summit-rays, length ·012 mm., thickness ·0033 mm. In the terminal character of the summit-rays this spicule resembles that represented by fig. 16.

The number of the rays in the candelabra spicules of *Corticium*, as remarked by Osc. Schmidt (Mexic. Spong. p. 69), varies in the same species to such an extraordinary extent, according to the degree of subdivision of the four normal rays of the typical calthrops spicule, that it is not easy to determine the number of species which these detached spicules may represent. But the character of the summit-rays of the spicules gives a probable clue, for whilst some are capped by small tubercles, others are claw-shaped and pointed, and others, again, have furcate ends, and each of these different forms may belong to a separate species; and in this case three, if not four, species are present in the Oamaru material. This genus is very sparsely represented in existing seas; not more than three or four species are known, and these are found in the Adriatic, off the coast of Algiers, Zebu, and St. Vincent. Only a single detached spicule has previously been discovered as fossil in Jurassic strata near Cracow.

Modified Stellate and Calthrops Spicules of Corticium.

Pl. XII. figs. 22–29. Spicules in which the number of rays varies from 3 to 14. In all the forms the rays are short, obtusely pointed, and frequently unequal in size in the same spicule. The simplest is a 3-rayed form (fig. 28); the rays are ·03 mm. in length by ·0067 mm. in thickness. Fig. 27 represents a minute calthrops spicule in which the rays are ·026 mm. in length. Fig. 29 is also of a calthrops type, but it has five rays, about ·016 mm. in length. In the other forms (figs. 22–26) the rays are more numerous, ranging from 6 to 14, and the spicules exhibit a stellate arrangement. The rays in these are short and obtuse, and appear very different from those of ordinary stellates. The diameter of these spicules ranges from ·021 to ·04 mm. In their general appearance they resemble spicules of *Corticium*; and in a recent Adriatic species, *C. stelligerum*, Osc. Sch. (Algier. Spong. p. 25, t. iii. fig. 6 *b*), there are stellate and small calthrops spicules, somewhat similar to these fossils.

Pl. XII. figs. 30, 31, 32.—Small spicules with from 4 to 7 rays, which do not radiate from a common centre but from a short linear axis. The rays are elongated, pointed, and together with the central axis are traversed by canals which open at their extremities. In fig. 30 there are 4 rays, ·075 mm. in length, which are in different planes. In fig. 31 there are six subequal rays, ·0217 mm. in length, which form, as it were, a double tripod. In fig. 32 there is a short central curved axis with three elongate rays at either end, and an additional ray starting from the middle of the axis. The rays in this form are minutely tuberculate, and ·021 mm. in length. These spicules can only provisionally be placed under *Corticium*, they may possibly belong to some other tetractinellid genus. In *Corticium stelligerum*, Osc. Sch., referred to above, there are some peculiar stellates in which the rays are given off from a thickened or elongate axis.

Candelabra Spicules of Plakina, *Schulze.*

Plakina australis, n. sp.—Pl. XII. fig. 20. Candelabrum with slightly curved tapering shaft and at its summit numerous curved rays, furcate at their ends. The rays are apparently 12 in number, and grouped in systems of four. Length of spicule

·033 mm., of the shaft ·025 mm.; length of summit-rays ·0083 mm. In the number of the summit-rays this form corresponds with the spicules of *Plakina trilopha*, Schulze (Zeitsch. f. wiss. Zool., Bd. xxxiv. (1880) p. 407, pl. xxi. figs. 12 α, β, η), but the rays in these latter are simply pointed.

Pl. XII. fig. 21. Spicule with a single, straight, tapering shaft which bifurcates at the summit and gives off on either side three pairs of short curved rays, with bifid ends. Length of spicule ·05 mm., of shaft ·033 mm., thickness of shaft ·003 mm.; length of summit-rays ·01 mm. This and the preceding form (fig. 20) probably belong to the same species, which may be termed *Plakina australis*. Spicules of this genus have not been previously met with as fossil; the existing forms are only known from the Mediterranean.

Calthrops, or four-rayed Spicules of Pachastrella, *Osc. Schmidt.*

Pl. XIII. fig. 35. Calthrops with three subequal rays and one ray shorter than the others. Two of the rays are slightly furcate, and two simple and pointed; axial canals are present in all. Longest ray ·17 mm. by ·023 mm.

Pl. XIII. figs. 36, 37, 38, 40. Calthrops spicules of different sizes, with smooth simple rays, which vary in length from ·023 to ·23 mm., and in thickness from ·0066 mm. to ·075 mm. In another specimen the rays are ·8 mm. in length.

Pl. XIII. fig. 39. Calthrops with rays unequal in length; three are smooth, whilst the other is thickly set with small conical spines, and in this ray alone is an axial canal visible. The longest ray is ·085 mm. by ·001 mm. in thickness.

As a rule the calthrops spicules in the Oamaru material are much smaller than those which are present in the Cretaceous and older rocks. They are fairly abundant in the coarser portions of the deposit associated with the large trifid spicules of *Geodites*, &c.

Spined Calthrops Spicule of unknown Sponge.

Pl. XII. fig. 37. Small calthrops spicule with short, conical, obtuse rays, armed with strong projecting spines. Length of rays ·021 mm., thickness ·005 mm. Detached spicules of a similar character, but larger than these fossils, are figured by Bowerbank in a recent undescribed sponge from Freemantle, Western Australia (Mon. Brit. Spong. vol. i. p. 268, pl. x. figs. 235, 236).

Trifid Skeletal Spicules of Triptolemus, *Sollas.*

Triptolemus australis, n. sp.—Pl. XIII. fig. 34. Spicules with a short fusiform shaft, pointed at both ends, from the centre of which three divergent rays extend horizontally and dichotomize three and occasionally four times. The rays are cylindrical or compressed, smooth, those of the second or third subdivision not always in one plane. All the rays are traversed by axial canals, which open at their extremities. Diameter of spicule ·3 mm., thickness of primary rays ·03 mm. Sponges with spicules similar to these were first described by Mr. Carter as *Pachastrella intexta* and *P. parasitica* (Ann. & Mag. Nat. Hist. s. 4, vol. xviii. 1876, pp. 409–10, pl. xv. fig. 41, pl. xvi. fig. 50). Subsequently Mr. Carter placed these forms under the genus *Samus* (Ann. & Mag. Nat. Hist. s. 5, vol. vi. 1880, p. 60), and they have since been placed in a distinct genus by Prof. Sollas (Chall. Report, vol. xxv. p. 93). It is very doubtful if the type species, *T. cladosus*, Sollas, is distinct from *T. parasiticus*, Carter, sp. The Oamaru specimens are notably larger than the spicules of recent forms, and they probably indicate a new species, which may be provisionally termed *Triptolemus australis*.

Trifid Spicules of Ditriænella *, n. g.

Ditriænella Oamaruensis, n. sp.—Pl. XII. figs. 34, 35. Spicules with fusiform shaft, pointed at both ends, and with two whorls of trifid rays. Each whorl is at an equal distance from the end of the shaft, and there is a short interspace in the centre of the shaft between the whorls. The normal three rays of each whorl are bifurcate; the rays are nearly horizontally extended, smooth, conical and obtusely pointed. Axial canals traverse the shaft and all the rays, and open at their ends. Length of shaft ·19 mm., thickness ·025 mm. Length of rays ·04 to ·075 mm., thickness ·012 mm. Detached spicules of a similar character to these forms are figured by Bowerbank under the names of 'Furcated spiculated biternate,' and described as interstitial tension spicula of *Farrea occa* (Mon. Brit. Spong. vol. i. p. 261, pl. ix. fig. 200;

* τρίαινα, a trident, dimin.

Proc. Zool. Soc. 1869, p. 341, pl. xxiv. fig. 6), from the Seychelle Islands. It is evident, however, that these spicules belong to Tetractinellid sponges, and in the position and character of the trifid rays they bear a certain resemblance to the spicules of *Triptolemus*, Sollas, with the difference, however, that there are two whorls of trifid rays instead of one. This difference seems to be of generic value, and we therefore propose to consider these double-trifid spicules as belonging to a new genus and species under the name of *Ditriænella Oamaruensis.*

Ditriænella (a).—Pl. XII. fig. 36. Spicules of the same character as the preceding, but very much smaller; the shaft and rays are armed throughout with conical spines; the rays of the whorls are simple, and not furcate. Length of spicule ·059 mm., thickness of shaft ·007 mm. Length of rays ·023 mm.

Acerate and Trifid Spicules of Geodites, *Carter*, Stelletta, *Osc. Sch., and allied Genera.*

Pl. XIII. figs. 1, 2. Fusiform acerate spicules, smooth, slightly curved, tapering to acute points. Length from 1·55 mm. to 3·25 mm., thickness about ·1 mm. The larger size of the spicules as compared with the corresponding forms figured on Pl. VII., indicate that they belong to Tetractinellid sponges. These spicules are common to several genera of this division. There are in the deposit numerous forms intermediate in size between those figured.

Geodites (a).—Pl. XIII. figs. 3, 4, 5. Trifid spicules with slightly curved tapering shafts and short head-rays projecting obliquely forwards. The rays are either simple (fig. 5) or furcate (figs. 3, 4). Length of spicules 2·7 mm. to 3·95 mm., thickness of shaft 1 mm.; length of head-rays ·25 to ·32 mm. These three forms probably belong to the same species.

Pl. XIII. fig. 19. Anchor trifid spicule; shaft straight, slender, very gradually tapering, head rounded, the three simple rays evenly recurved. Total length uncertain, thickness of shaft ·05 mm., length of head-rays ·24 mm. This form probably belongs to the same species as the trifid spicules referred to above.

Similar detached trifid spicules have been described by Mr. Carter from the Lower Greensand of Haldon, Devonshire, under the name of *Geodites Haldonensis* (Ann. & Mag. Nat. Hist. s. 4, vol. vii. 1871, p. 129, pl. x. figs. 58–67); they also occur in the same formation in Kent and in the Upper Chalk of Norfolk. Very similar spicules both in form and proportion occur in the recent *Stelletta* (*Anthastra*) *pyriformis*, Sollas, sp. (Chall. Rep. vol. xxv. p. 146, pl. xv. figs. 3–7), from Port Jackson, at depths of from 30–35 fathoms.

Geodites (b).—Pl. XIII. fig. 6. Trifid spicule, with straight, scarcely tapering shaft and small furcate head-rays. The shaft is incomplete, the portion remaining is 3·25 mm. in length and ·1 mm. in thickness; the head-rays are ·17 mm. long.

Pl. XIII. figs. 7, 8. Trifid spicules with straight, stout, tapering shafts; head-rays simple or furcate, their ends nearly horizontal or slightly recurved. Axial canals distinctly shown in the shaft and head-rays. Length of spicule ·9 mm., thickness of shaft ·075 mm. to ·1 mm.; length of head-rays ·2 mm.

Stelletta (a).—Pl. XIII. figs. 9, 10. Trifid spicules with stout tapering shafts and short simple head-rays, projecting obliquely forwards or slightly recurved at the ends. Length of spicule 1·75 to 2·6 mm., thickness of shaft ·09 mm.; length of head-rays ·225 mm. Similar forms occur in the Upper Chalk of Norfolk (Hinde, Foss. Sponge Spic. pl. iii. figs. 7, 10) and in the recent *Stelletta reticulata*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. xi. 1883, p. 352, pl. xiv. fig. 4 *b*), from the S. coast of Australia.

Pl. XIII. figs. 11–15. Trifid spicules with straight or curved tapering shafts and short head-rays, either simple or furcate. Fig. 11, which is much smaller than the others, is only ·46 mm. in length by ·04 mm. in thickness; the head-rays are nearly horizontal and ·084 mm. in length. In figs. 12, 13 the spicules are 1·3 mm. in length and about ·18 mm. in thickness; the head-rays, which are furcate and project obliquely forwards, measure ·3 mm. in length. In figs. 14, 15 the spicules are from ·95 to 1·5 mm. in length; the shafts are ·09 mm. in thickness, and the small simple pointed head-rays are only ·1 mm. long. These trifid spicules probably represent two or three species of *Geodites* or *Stelletta*.

Pl. XIII. figs. 16, 17. Trifid spicules with elongate shafts and relatively long, simple head-rays extending nearly directly forwards. The shafts are from ·04 to ·09 mm. in thickness: in fig. 16 the head-rays are ·24 mm. in length by ·02 mm. in thickness; in fig. 17 the head-rays are unequal in size, the longest measures ·67 mm. by ·1 mm. in thickness. Similar 'fork' spicules are known from the Chalk of Norfolk (Hinde, Foss.

Sponge Spic. p. 35, pl. ii. figs. 17, 18) and in the recent *Craniella* (*Tethea*) *cranium* (see Mon. Brit. Spong. vol. i. pl. 31. fig. 362 *a*).

Thenea (a).—Pl. XIII. fig. 18. Trifid spicule with slender tapering shaft, rounded harpoon-like head, and long, slender, strongly recurved head-rays. The shaft is incomplete, it is ·01 mm. in thickness; the head-rays are ·128 mm. in length by ·01 mm. in thickness. This spicule resembles the trifids in the recent *Thenea* (*Tisiphonia*) *fenestrata*, Osc. Sch., sp., as figured in the 'Challenger' Report (vol. xxv. pl. viii. fig. 3), but the rays are less elongated.

Pl. XIII. figs. 20–24 *a*. Trifid spicules with elongated shafts and simple head-rays, recurved at different degrees. The shafts vary from ·03 to ·04 mm. in thickness; the head-rays are from ·07 to ·2 mm. in length. Though the differences in form are slight, yet, judging from recent sponges, these anchor trifid spicules probably represent four or five species. A detached spicule nearly similar to 24 *a* is present in the 'Egeria' dredgings from off the S.W. coast of Australia, at a depth of 2479 fathoms.

The trifid spicules referred to above are very abundant in some portions of the Oamaru material, where they constitute the major portion of the sponge-spicules present, in other portions of the material they are somewhat rare. It is difficult to determine the number of species they may represent, possibly not more than five or six, and equally difficult to refer them to particular genera, since this chiefly depends on the character of the flesh-spicules associated with these skeletal forms. Trifid spicules of the same character as those figured are common wherever sponge-spicules occur in the older rocks, and they are known from the Carboniferous formation upwards, being specially abundant in the Lower and Upper Greensand and in the Upper Chalk of this country. As detached forms, they are numerous in recent dredgings, and they occur from off the S.W. coast of Australia in material from a depth of 3000 fathoms.

Globate Spicules of Geodites, *Carter.*

Pl. XIV. figs. 32, 32 *a*. Globates varying from nearly spherical to ellipsoidal in form. An ellipsoidal specimen measures ·093 mm. by ·04 mm., whilst a nearly spherical individual is ·121 mm. by ·095 mm. These spicules are fairly abundant in the Oamaru deposit, and they show the same structural details as the globates of recent species of *Geodia*. It is probable that the differences in size and form may indicate different species. Fig. 32 *a* represents a portion of the surface of a globate, showing the spined heads of the extremely fine acuate spicules of which it is composed.

Discoidal Spicules of Erylus, *Gray*.

Erylus (a).—Pl. XIV. fig. 33. Discoidal spicules, elliptical in outline, consisting of an aggregate of hair-like spicules, the summits of which project slightly as small spines. These spicules vary considerably in size: a small specimen is ·113 mm. in length by ·076 mm. in width; whilst a large form, like that figured, is ·175 mm. by ·122 mm. As a rule these spicules are larger than those of the recent *Erylus* (*Stelletta*) *mamillaris*, Osc. Sch., sp., the type of the genus. As fossil these spicules only appear to have been hitherto noticed in the Tertiary radiolarian beds of Barbados, by Mrs. Bury ('Figures of remarkable forms of Polycystines in the Barbados Chalk Deposit,' 1862, pl. xxiii. fig. 2). Detached recent spicules are plentiful in dredgings from off the S.W. coast of Australia in depths of 3000 fathoms.

Erylus (b).—Pl. XIV. fig. 34. Extremely thin, circular or elliptical, plane or plano-concave discs or plates, consisting of an aggregate of delicate acuate spicules radiating from a centre. Their surfaces are minutely tuberculate, and their summits rounded. Length ·125 mm., width ·105 mm. These spicules are of the same character as the dermal spicules of *Erylus* (*Stelletta*) *euastrum*, Osc. Sch. (Algier. Spong. 3rd Supp. p. 20, pl. iv. figs. 4 *a*, *b*, *c*, *d*), from off the coast of Algiers.

Dermal Spicules of unknown Sponge (Dactylocalycites, *Carter*; Placolithis, *pars*, *Ehrenberg*).

Pl. XIV. figs. 35, 36, 37. Thin siliceous plates, circular, elliptical or suboblong in outline, with a series of flask-shaped, round or elongate perforations just within the margin and a varying number of fine canals either extending across the spicule or radiating from the centre. These canals terminate just within the spicular margin in the spaces between the flask-shaped perforations. They vary in number: in a small specimen (fig. 37) there are only three, which extend across the plate, but do not appear to interconnect where they cross each other; in larger forms there are from 9 to 18 canals, which appear to radiate from a common centre. In most forms there is one canal in the form of a loop or curve. Not infrequently the canals are so fine as to be only partially visible.

This form of spicule was first described by Mr. Carter from the Upper Greensand of Devonshire, and similar spicules have subsequently been described from the Upper Chalk of Westphalia and Norfolk. They have been figured by Dr. Rüst from the radiolarian Jurassic marls of Ilsede, Hanover ('Palæontographica,' Bd. xxxi. pl. xx. fig. 42); and they also occur in the Tertiary radiolarian earth of Barbados (Bury, 'Polycystines in the Barbados Chalk Deposit,' 1862, pl. vii. figs. 1, 2); and Ehrenberg has figured an imperfect specimen said to have been dredged up from a depth of 13,200 feet in the Indian Ocean between Zanzibar and the Seychelles (Microgeol. Studien, 1873, p. 147, pl. 36. fig. 9), to which he gave the name of *Placolithis lacunosa*. A detached spicule also occurs in the 'Egeria' dredgings off the S.W. coast of Australia at a depth of 3000 fathoms. Hitherto no recent sponge has been discovered with similar spicules. It seems probable that they may be dermal spicules, but they are of quite a different character from the globates of *Geodia* or the discoidal spicules of *Erylus*. The Oamaru forms are smaller, and show a greater variation in outline than those from the Upper Chalk.

Globostellate Spicules with truncate and lobed rays.

Stelletta (b).—Pl. XIV. figs. 28, 29. Spicules subspherical in outline, consisting of a solid centre or nucleus from which numerous short rays or arms project in different directions. The rays are stout, subcylindrical, with truncate and expanded summits, usually divided into lobes. In each ray there is an axial canal. The spicules appear to have been interlocked together by means of the lobate ends of the rays. Total thickness of spicule ·1 mm.; length of rays ·025 mm., thickness ·018 mm.; width of their summits from ·02 to ·026 mm. These spicules resemble in character the globostellates of *Stelletta intermedia*, Osc. Sch. (Algier. Spong. 3rd Supp. p. 21, pl. iv. fig. 6), but the arms are shorter and their summits more expanded. According to Schmidt, the rays of these recent spicules intergrow together. Somewhat similar, but much smaller, spicules are also present in *Stelletta reticulata*, Carter (Ann. & Mag. Nat. Hist. s. 5, vol. xi. 1883, p. 352, pl. xiv. fig. 4 *e*), from off the S. coast of Australia.

Similar spicules likewise occur detached in the 'Egeria' dredgings off the S.W. coast of Australia, at a depth of 3000 fathoms.

Stelletta (c).—Pl. XIV. fig. 30. Globostellate with numerous stout conical rays, divided at the apex into two or three small spines or lobes. Diameter of spicule ·102 mm., length of rays ·025 mm., thickness ·02 mm.

Pl. XII. fig. 33. Globostellate with short subcylindrical truncate rays, in number 10 or 12, their summits are bi- or tripartite and spined. Diameter of spicule ·015 mm., length of rays ·0055 mm., thickness ·0035 mm. This form somewhat resembles the globostellates of *S. globostellata*, Carter, referred to above, but it is much smaller. In the character of the rays it is similar to the spicules of *Dictyocylindrus dentatus*, Bowk. (Proc. Zool. Soc. 1873, p. 321, pl. xxix. figs. 3, 4), but these latter possess only 6 rays, and they are moreover much larger forms.

Stellate and Globostellate Spicules of Stelletta, *Osc. Schmidt, and allied Genera.*

Stelletta (d).—Pl. XIV. figs. 15, 16. Stellate spicules with elongate tapering rays, without any definite centre. Rays smooth, acute or obtusely pointed, from 5 to 10 in number. Length ·04 mm. to ·044 mm., thickness at base ·0033 mm. Similar stellates are present in *Stelletta Wageneri*, Osc. Sch. (Adriat. Spong. p. 46, pl. iv. figs. 3 *e*, *f*), and in *Pachymatisma contorta*, Bowk. (Proc. Zool. Soc. 1873, p. 327, pl. xxxi. fig. 10), from off the Fiji Islands.

Pl. XIV. fig. 19. Globostellate with small well-defined centre and about 9 smooth, conical, tapering rays. Diameter of spicule ·09 mm.; of centre ·012 mm. Length of rays ·035 mm. This form differs from the preceding in having a definite centre.

Globostellate Spicules of Tethya, *Lamarck, and other Genera.*

Tethya (a).—Pl. XIV. figs. 17, 20, 22, 24. Globostellate spicules with stout, conical, pointed or obtuse rays, from 9 to about 28 in number. The rays are usually smooth, but occasionally minutely tuberculate, with canals in each, which open at the end of the rays. The diameter of the smallest specimen (fig. 22) is ·05 mm., length of rays ·0017 mm. The diameter of the largest is ·184 mm., length of rays ·078 mm. These spicules are fairly numerous in the deposit; they resemble the spicules of

Tethya, but as a rule they are larger than the globostellates of *T. lyncurium*, Linn. Spicules of this type are, however, not restricted to *Tethya*, for Carter has figured very similar forms in *Stelletta globostellata* (Ann. & Mag. Nat. Hist. s. 5, vol. xi. p. 353, pl. xiv. fig. 5 *e*). Detached spicules of the same form are present in the 'Egeria' dredgings off the S.W. coast of Australia, at a depth of 2479 fathoms.

Pl. XIV. figs. 18, 18 *a*, 21. Small globostellates having from 8 to 15 rays. The rays are short, subcylindrical, truncate or slightly inflated at the extremities. A small specimen is ·011 mm. in diameter, and the rays ·004 mm. in length. A large specimen (fig. 21) measures ·015 mm. across, and the rays are ·0067 mm. in length. Spicules similar to these are present in recent species of *Tethya* associated with the larger spicules described above. In *Geodia tuberculosa*, Bowk. (Proc. Zool. Soc. 1872, p. 626, pl. 46. fig. 8), there is also a form similar to fig. 21, and the same type of spicule is present in other species of *Geodia* and *Stelletta*.

Pachastrella (a).—Pl. XIV. figs. 23, 31. Small globostellates in which the rays are reduced to small, conical, pointed or obtuse tubercles projecting slightly above the surface of the centrum. Diameter of spicules ·016 mm. to ·02 mm. Spicules of this character are present in the recent *Pachastrella exostotica*, Osc. Sch. (Algier. Spong. p. 16, pl. iii. fig. 12), from the Mediterranean, also in *P. geodioides*, Carter (Ann. & Mag. Nat. Hist. s. 4, vol. xviii. 1876, p. 407, pl. xiv. fig. 23 *m, o*), and in *Cydonium esoaster*, Sollas (Chall. Rep. vol. xxv. p. 225, pl. xxi. fig. 23), from Port Jackson.

Stellate Spicules with Spined Rays.

Pl. XIV. figs. 25, 26. Comparatively large stellate spicules with from 6 to 10 elongate conical rays, which are furnished with stout spines projecting directly outwards. Axial canals are present in all the rays. Diameter of spicules from ·09 mm. to ·105 mm., length of rays ·04 to ·055 mm. Spicules of this character do not appear to have been figured in recent sponges.

Pl. XIV. fig. 27. Small stellate with 8 stout conical rays, which are thickly set with small spines. Diameter of spicule ·03 mm. This form is much smaller than the preceding.

III. LITHISTIDÆ.

Body-Spicules of Lithistid Sponges.

Lyidium (a).—Pl. XIII. figs. 25, 26, 27. Spicules of various forms, with an elongate, subcylindrical main axis, usually curved, which bifurcates or gives off lateral branches, terminating either with transverse convex expansions or obtusely. Surface smooth. Without axial canals. Length of spicules from ·42 mm. to ·81 mm., thickness of axis ·08 mm. to ·122 mm. These spicules are of the usual types present in Megamorine sponges, such as, for example, *Doryderma*, Zitt., and other allied fossil genera. They are smaller than the spicules of the recent genus *Lyidium*, Osc. Sch. These forms are not very abundant in the Oamaru material. Fossil spicules of the same character are present from the Carboniferous upwards, and they are very common in the Lower and Upper Greensand and the Upper Chalk of the South of England. They appear to be scarce in recent seas.

Body-Spicules of Vetulina, *Osc. Schmidt.*

Vetulina Oamaruensis, n. sp.—Pl. XIII. figs. 31, 32, 33. Spicules with definite centres, either rounded or irregular in form, from which a variable number, generally from five to seven, short, thick, straight or curved rays or branches are given off in different directions. The rays are usually simple, but occasionally, as in fig. 33, they are bifurcate, and they terminate in lobed and saddle-shaped expansions. In some spicules the centres have stout conical spines as well as rays, and the rays themselves are sometimes armed with spines. No canals can be distinguished. The spicules range from ·14 to ·2 mm. in diameter, the centres are about ·05 mm. in thickness, the rays are from ·051 mm. to ·075 mm. in length.

These spicules are of the Anomocladina type; they correspond with those of the fossil genus *Mastosia*, Zitt., and the recent *Vetulina*, Osc. Sch., but they indicate a distinct species, which may be termed *Vetulina Oamaruensis*. Sponges with this type of spicule are not uncommon in the Jurassic strata of Germany, they are rare in the Cretaceous rocks, and only one existing species, *V. stalactites*, Osc. Sch. (Mexican Spong. p. 19, pl. i. fig. 1, pl. ii. fig. 9), from off Barbados at 100 fathoms, is as yet known.

Body-Spicules of Tetracladine Lithistid Sponges.

Pl. XIII. figs. 28, 29, 30. Spicules with four rays, usually unequal in length, which occasionally subdivide and terminate obtusely. The rays are throughout studded with prominent tubercles. The spicules are from ·22 to ·48 mm. in length, and the principal rays about ·066 mm. in thickness. These spicules are of the same character as those of the Cretaceous genus *Plinthosella*, Zittel, and of the recent *Discodermia*, Bocage.

Dermal Spicules of Lithistid Sponges.

Corallistes (a).—Pl. XIV. figs. 1, 7. Spicules with short conical shaft and horizontally extended head, consisting of six simple, narrow, obtusely pointed rays, resulting from the bifurcation of the normal three rays. Axial canals extend throughout the rays and open at their ends. Width across head of spicule from ·15 mm. to ·36 mm. Spicules of similar character form the dermal layer in *Heterostinia*, Zitt., and other genera of fossil Cretaceous sponges, and in the recent *Corallistes*, Osc. Sch. (Atlant. Spong. p. 22, pl. iii. fig. 3).

Corallistes (b).—Pl. XIV. fig. 6. Spicule with rudimentary shaft and horizontal head of six flattened rays. Diameter of head ·5 mm., length of secondary rays ·22 mm., width ·07 mm. This form is very abundant. Similar spicules occur in *Thamnospongia* and other Cretaceous genera, and in the recent genus *Corallistes*.

Theonella (a).—Pl. XIV. fig. 4. Spicule with short shaft and three flattened, horizontally extended head-rays, one simple and rounded at the end, the others slightly furcate. Diameter of spicule ·8 mm., width of rays ·125 mm. No canals are visible in this form. Somewhat similar spicules are present in the recent genus *Theonella*, Gray.

Discodermia (a).—Pl. XIV. figs. 2, 3, 5. Spicules with reduced shafts and widely expanded head, in which the normal rays are much subdivided. The rays are smooth, compressed, and end obtusely. An axial canal is present in the shaft, but the canals of the head-rays are quite rudimentary. Diameter of spicules ·9 mm., thickness of primary rays ·075 mm. Spicules of this character are very abundant in the Lower and Upper Greensand and in the Upper Chalk of the South of England, but, as in this Oamaru deposit, they are detached from the sponges to which they belonged. Smaller spicules of the same type also occur in the recent *Discodermia*, Bocage. Detached spicules, similar to figs. 2 and 3, are present in the 'Egeria' dredgings off the S.W. coast of Australia at a depth of 2479 fathoms.

Pl. XIV. figs. 8, 9, 10, 11. Spicules in which the shafts are much reduced or obsolete, and the heads are of thin siliceous plates with rounded or slightly sinuous outlines. In fig. 8 there is no trace of a shaft nor of axial canals, the border of the plate is smooth and the central portion tuberculate; in fig. 9 the surface, with the exception of the outer border, is dotted over with minute curved dimples, and there are three rudimentary canals; in fig. 11 the canals are much longer than is usually the case with these forms. The spicules are about ·15 mm. in diameter. Spicules of this type (with the exception of fig. 11) are present in the dermal layer of the recent *Discodermia*, Bocage.

Discodermia sinuosa, Carter.—Pl. XIV. fig. 12. Spicule with short shaft, head-plate flat with margins deeply laciniate and notched. Surface except near margins pitted over with small depressions. Diameter ·215 mm. Spicules similar to this form, but somewhat smaller, are present in *Discodermia sinuosa*, Carter, from the Gulf of Manaar (Ann. & Mag. Nat. Hist. s. 5, vol. vii. 1881, p. 372, pl. xviii. fig. 1 *c*, *d*).

Dermal Spicules of undetermined Genus.

Pl. XIV. fig. 13. Spicule with short blunted shaft and horizontally extended head, in which each of the normal three primary rays subdivides into three subequal rays. The rays are subcylindrical, tapering slightly and obtusely ended, and their surfaces are thickly covered with minute spines. Canals extend into each ray and open at their extremities. Diameter across head ·091 mm., length of secondary rays ·04 mm.

Pl. XIV. fig. 14. Spicule with straight, subcylindrical, obtusely ended shaft, with two primary rays at the summit, each of which divides into three secondary rays. Only the base of the third normal ray appears in this spicule. The rays are spined the same as in the preceding form. Diameter across head ·081 mm., length of secondary rays ·02 mm., length of shaft ·071 mm.

This and the preceding (fig. 13) probably belong to the dermal layer of a Lithistid sponge. In the trifurcate division of the head-rays these spicules singularly resemble the head-rays of *Samus anonyma*, Gray, as figured by Mr. Carter (Ann. & Mag. Nat. Hist. s. 5, vol. iii. 1879, pl. xxix. fig. 3), but the spicules of this sponge have similar trifurcate rays at both ends of the shaft. A detached spicule resembling fig. 14, but having three normal rays, is figured by Bowerbank as probably belonging to a species of *Dactylocalyx* (Proc. Zool. Soc. 1869, pl. iii. fig. 16), but this is an error, since this genus is hexactinellid.

Summary of Genera and Species of Tetractinellid and Lithistid Sponges represented in the Oamaru Deposit.

TETRACTINELLIDÆ.

No. of Species.	
4 sp.	*Corticium*, Osc. Schmidt.
1 sp.	*Plakina*, F. E. Schulze.
2 sp.	*Pachastrella*, Osc. Schmidt.
1 sp.	*Triptolemus*, Sollas.
2 sp.	*Ditriænella*, g. n.
6 sp.	*Geodites*, Carter, *Stelletta*, Osc. Schmidt, and allied genera.
2 sp.	*Erylus*, Gray.
2 sp.	*Tethya*, Lamarck.
2 sp.	Genus undetermined.
22 sp.	

LITHISTIDÆ.

1 sp.	*Lyidium*, Osc. Schmidt.
1 sp.	*Vetulina*, Osc. Schmidt.
2 sp.	*Corallistes*, Osc. Schmidt.
2 sp.	*Discodermia*, Bocage.
1 sp.	Genus undetermined.
7 sp.	

From these lists it appears that there are 22 species and 9 genera of Tetractinellid sponges, and only 7 species and 5 genera of Lithistid sponges in the Oamaru deposit. These numbers can only be considered as approximate, but it is probable that they are under rather than overestimated. Though in the number of species the Tetractinellid sponges fall far short of the Monactinellids, yet in certain portions of the rock their remains far exceed those of other kinds and constitute the large majority of spicules present. Most of the Tetractinellidæ belong to genera well represented in the Cretaceous and even older rocks, as well as existing at the present day; other genera, such as *Corticium* and *Plakina*, are rare at present and restricted in their distribution. Lithistid sponges are but sparsely represented; two of the three genera recognized, *Lyidium* and *Vetulina*, are rare in the present day, but they belong to families which date back from the Carboniferous epoch. In comparison with the number of species in the Oamaru deposit, it may be mentioned that the 'Challenger' Expedition only obtained 25 species of Tetractinellids from the entire South-Australian Region, in which New Zealand is situate, and but a single species of Lithistid from the same region (Chall. Rep. vol. xxv. p. 387).

IV. HEXACTINELLIDÆ, *Osc. Schmidt.*

Acerate Spicule of Hexactinellid Sponge.

Pl. XV. fig. 1. Spicule straight, fusiform, with a slight subcentral inflation, gradually tapering to either end; surface with minute spines, more numerous near the ends and sparse in the central portion, they project at right angles to the surface. An axial canal traverses the spicule and opens at either end; in the centre there is a distinct nodal swelling. Length of spicule ·48 mm., greatest thickness ·015 mm. The central inflation of the axial canal indicates that this form belongs to some hexactinellid sponge. Acerate spicules, smaller than this fossil and without spines, are present in the recent *Euplectella nodosa*, Schulze (Chall. Rep. vol. xxi. p. 82, pl. xiv. figs. 3, 4), from near the Bermudas.

Pinule Spicules with Six Rays.

Pl. XV. fig. 2. Transverse and proximal rays of the spicule subequal, straight or slightly curved, and minutely spined near the ends; the spines on the distal ray thickly set, projecting upwards, the end of the ray extends beyond the spines. Length of the distal ray ·137 mm., width (including spines) ·029 mm., length of the other rays ·069 mm., thickness ·01 mm. Pinules of similar form, but larger, are figured by Schulze in *Aulascus Johnstoni* (Chall. Rep. vol. xxi. p. 118, pl. xxii. fig. 3), from the Indian Ocean at a depth of 310 fathoms.

Pl. XV. fig. 3. Spicules of the same character as the preceding, but the distal ray is shorter, the spines on it are less upright and thicker set in the middle portion of the ray. Axial canals traverse all the rays and open at their ends. Length of distal ray ·087 mm., width ·035 mm., the transverse and proximal rays are ·07 mm. in length. Similar but smaller pinules are present in *Caulophacus latus*, Schulze (Chall. Rep. vol. xxi. p. 124, pl. xxiv. fig. 10), from west of the Crozet Islands, in Diatom ooze, at a depth of 1600 fathoms.

Pl. XV. fig. 4. Resembling the preceding, but the transverse and proximal rays are proportionately longer and the spines on the distal ray more bushy, so that it has an ovate outline. Length of distal ray ·076 mm., width ·03 mm., length of the other rays ·07 mm. Pinule spicules of the same character as this are present in *Polyrhabdus oviformis*, Schulze, and in *Balanites pipetta*, Sch. (Chall. Rep. vol. xxi. pp. 121, 122, pl. xxiii. figs. 4, 13), both from the Antarctic Ocean, in Diatom ooze, at depths of 1950 and 1975 fathoms.

Pinule Spicules with Five Rays.

Pl. XV. fig. 6. The transverse rays are either horizontal or with a slight upward curvature, their surfaces covered with small spines or tubercles. Distal ray with strong curved and thick spines, the end of the ray extends beyond the spines. Length of distal ray ·06 mm., width ·036 mm., length of transverse rays ·022 mm. Similar but somewhat larger pinules are present in *Hyalonema globus*, Sch. (Chall. Rep. vol. xxi. p. 221, pl. xl. fig. 16), from near the Banda Islands, at a depth of 360 fathoms.

Pl. XV. fig. 7. Pinule with stout, obtusely pointed, transverse rays, thickly set with spines; distal ray short, truncate, with short, straight hooked spines, nearly similar to those of the basal rays. Axial canals well marked. Length of distal ray ·059 mm., thickness ·02 mm., length of transverse rays ·06 mm.

Pl. XV. fig. 5. Pinule with smooth, nearly horizontal, transverse rays and a stout short distal ray which in the upper portion has a group of thickly set curved spines which are all of about equal height, so that the ray appears as if truncate. Length of distal ray ·027 mm., width across spines ·018 mm., length of transverse rays ·018 mm.

Pl. XV. fig. 8. Pinule with smooth, horizontal, transverse rays; distal ray elongate, with stout curved hook-like spines, extending obliquely upwards. Axial canals very wide in the form figured. Length of distal ray ·16 mm., greatest width ·042 mm., length of transverse rays ·06 mm. In recent sponges the spicule nearest in form to this occurs in *Pheronema Annæ*, Leidy (see Chall. Rep. vol. xxi. p. 239, pl. xlii. fig. 8).

Pl. XV. fig. 9. Pinule with very short, minutely spined, transverse rays, and an elongate tapering distal ray, with some stout conical hooked spines in the lower third of the ray. Length of distal ray ·432 mm., width ·048 mm., length of transverse rays ·032 mm. In the character of the distal ray the pinules of the recent *Hyalonema elegans*, Sch. (Chall. Rep. vol. xxi. p. 223, pl. xxxi. fig. 4), approach this form, but the spines are not restricted to the lower portion of the ray as in this fossil.

Pinule spicules are extremely rare as fossils; hitherto the only forms known are casts in chert from the Jurassic strata of Ilsede, Hanover, described by Dr. Rüst ('Palæontographica,' Bd. xxxi. p. 321, pl. xx. fig. 30), and by Wisniowski, from near Cracow (Jahrb. d. k.-k. geolog. Reichsan. Wien, Bd. xxxviii. 1888, 4 Heft, p. 679, pl. xii. fig. 42).

Rosette Spicules of Hexactinellid Sponges.

Pl. XV. fig. 10. Rosette in which some of the primary rays are furcate whilst others are undivided. The rays are smooth, straight or with a slight curve, and acutely pointed. Diameter of spicule ·056 mm., length of secondary rays ·021 mm. Spicules of this type are present in *Caulophacus latus*, Schulze (Chall. Rep. vol. xxi. p. 124, pl. xxiv. fig. 8), already referred to.

Pl. XV. fig. 11. Rosette in which each primary ray gives off four secondary rays. Rays straight, smooth, and acutely pointed. Diameter of spicule ·065 mm., length of secondary rays ·027 mm. These forms are fairly abundant in the Oamaru material. Recent spicules of similar character are present in *Acanthascus cactus*, Sch. (Chall. Rep. vol. xxi. p. 148, pl. 57. fig. 3), from the Japanese Seas.

Crateromorpha (a).—Pl. XV. fig. 12. Rosette with numerous rays, about 24 can be counted. The rays are stout, cylindrical, straight or slightly curved, extremities capped with convex discs, surrounded by a fringe of about 12 minute teeth. The surface of the rays is minutely tuberculate. The primary rays of the spicule are so short as to be concealed from view, and the secondary rays appear to radiate direct from a centre. Diameter across spicule ·16 mm., length of rays ·08 mm., thickness ·006 mm. Many of the rays are now fractured; it is probable that when complete there may have been from 30 to 40. Rosettes somewhat smaller, but with rays of the same character as this fossil, are present in *Crateromorpha tumida*, Schulze (Chall. Rep. vol. xxi. p. 166, pl. 67. fig. 6), from near the Banda Islands, at a depth of 360 fathoms.

Crateromorpha (b).—Pl. XV. fig. 13. Rosette of the same character as the preceding, but the rays are much more robust and somewhat shorter in proportion. The convex discs capping the rays are fringed with teeth. The rays appear to start from a thickened globate centre; most of them are now incomplete, but judging by the stumps that remain there would have been from 30 to 40 originally. Length of rays ·0875 mm., thickness at base ·0125 mm., width of capitate disc ·025 mm. The rays of this rosette are much stouter than in any recent spicule of this type.

Amphidisc Spicules of Hyalonema, *Gray, and* Pheronema, *Leidy.*

Hyalonema (a).—Pl. XV. fig. 14. Amphidisc with four rays, as if two of the normal forms had been welded together by the shafts. The shafts are elongate, slightly inflated where they are united, and with a few scattered tubercles. The terminal rays, about six in number at each end, are strap-shaped, irregularly curved and twisted, occasionally bifurcate and openly divergent. Diameter of spicule ·22 mm., width across rays ·101 mm., thickness of shaft ·009 mm. This peculiar spicule may be only an abnormal form. Amphidiscs with four rays are, however, present in the recent *Hyalonema tenerum*, Sch. (Chall. Rep. vol. xxi. pl. xxxi. fig. 18).

Hyalonema (b).—Pl. XV. fig. 15. Amphidisc with elongate slender shaft, with a subcentral whorl of nodes, the surface with small tubercles. Head-rays about six in number at each end, elongate, lingulate, nearly straight or slightly curved towards the shaft. Length of spicule ·189 mm., width across head-rays ·04 mm., length of rays ·065 mm. In the comparatively small number of the rays this form is distinct from any of the recent amphidiscs figured in the 'Challenger' Report; the nearest approach to it is the large amphidisc in *Hyalonema lusitanicum*, Bocage (see Chall. Rep. vol. xxi. pl. xxviii. fig. 14).

Hyalonema (c).—Pl. XV. fig. 16. Amphidisc with slender shaft (covered with stout spines and with a subcentral whorl of spines), and with long, slender, narrow, pointed terminal rays, the ends of which curve slightly outwards. Length of spicule ·17 mm., width across head-rays ·045 mm., length of head-rays ·07 mm., thickness of shaft ·005 mm. The summit-rays are incomplete, the full number being eight at each end. This spicule is of the same character as the large amphidisc in *Hyalonema depressum*, Schulze (Chall. Rept. vol. xxi. pl. xxxv. fig. 4), but it is distinctly smaller.

Hyalonema (d).—Pl. XV. fig. 17. Amphidisc with stout, slightly tuberculated shaft, having a median whorl of small nodes. The summit-rays are elongate, spatuloid, pointed at the ends and incurved. There appear to be eight at each end. Summit of spicule flattened, convex. Length of spicule ·21 mm., width across rays ·06 mm., length of head-rays ·095 mm., thickness of shaft ·01 mm.

Hyalonema (e).—Pl. XV. fig. 18. Spicule with stout shaft, armed with a few scattered tubercles; the summit rays, about six in number, are stout, short, and openly curved. Length of spicule ·31 mm., width across rays ·1 mm., length of rays ·088 mm., thickness of shaft ·02 mm. This spicule is very similar in character and dimensions to the large amphidisc in *Hyalonema Sieboldi*, Gray (see Chall. Rep. vol. xxi. pl. xxvii. fig. 7), but instead of 8 it has only 6 summit-rays at each end.

Hyalonema (f).—Pl. XV. fig. 19. Amphidisc with shaft having some small spines in the central portion; summit-rays, six at each end, ligulate, evenly curved. Length of spicule ·09 mm., width across rays ·03 mm., length of rays ·036 mm., thickness of shaft ·0067 mm. This form is distinctly smaller than those described above.

Hyalonema (g).—Pl. XV. fig. 20. Amphidisc with robust shaft, smooth with the exception of a subcentral whorl of small tubercles. The summit-rays, 8 at each end, are curved, spatulate, and elongate, so that there is only a short central interspace between them. Length of spicule ·208 mm., width across rays ·09 mm., length of rays ·087 mm., thickness of shaft ·015 mm.

Pl. XV. fig. 21. Small amphidisc, shaft slender, having a few spines in the central portion; rays delicate, acutely pointed, and evenly curved and elongate, so as nearly to meet in the centre. There appear to have been from 10 to 12 rays at each end in this spicule when complete, the greater number have been broken off. Length of spicule ·1 mm., width across rays ·05 mm., length of rays ·045 mm., thickness of shaft ·005 mm.

Hyalonema (h).—Pl. XV. fig. 26. Small amphidisc, shaft smooth, with slightly convex discs at either end, and 8 or 10 slightly projecting curved rays. Somewhat similar amphidiscs are present in *Hyalonema Thomsoni*, Marshall (see Chall. Rep. vol. xxi. pl. xxxiv. fig. 7). Length of spicule ·056 mm., width across summit ·023 mm., thickness of shaft ·003 mm.

The number and variety of form of the amphidisc spicules referred to above indicate that the hexactinellid sponges to which these flesh-spicules belong were numerously represented in the Oamaru strata. In all, 9 examples are figured, indicating probably 5 or 6 species. The principal recent genera characterized by amphidiscs are *Hyalonema*, Gray, *Pheronema*, Leidy, and *Semperella*, Gray; and it is probable that most of our fossils belong to the first named, though it is certain that one species of *Pheronema* is present. None of the fossil amphidiscs is sufficiently similar to any of the recent to be considered as belonging to the same species. Fossil amphidisc spicules are extremely rare, but an undoubted cast of one has already been described by Wisniowski from Jurassic strata at Cracow (Jahrb. der k.-k. geol. Reichsan. Wien, Band xxxviii. 4 Heft, p. 679, pl. xii. fig. 38).

Scopule Flesh-Spicules of Hexactinellid Sponges.

Aphrocallistes (a).—Pl. XV. fig. 24. Shaft incomplete; the upper portion of the spicule consists of four simple rays, which curve gracefully outwards; they are thickest at their bases and gradually taper upwards, terminating in a small bead-like inflation. The surface of these rays is minutely tuberculate. Length of rays ·07 mm., thickness at base ·01 mm., thickness of shaft ·0056 mm. The scopules in recent hexactinellids nearest to this form occur in *Aphrocallistes Bocagei*, Wright (see Chall. Rep. vol. xxi. pl. lxxxiv. fig. 3), from Japan, and in *Chonelasma hamatum*, Schulze (*l. c.* p. 323, pl. xci. fig. 4), from the South Pacific, at a depth of 630 fathoms.

Pl. XV. fig. 25. Scopule with cylindrical, slightly curved shaft, the summit of which is inflated and supports four straight simple cylindrical rays, which slightly diverge from one another above. These rays are minutely tuberculate, their summits are smooth and rounded, but not inflated. The axial canal in the shaft of the spicule is much enlarged, and there is a rounded inflation at the top from which extensions are given off into the rays. Length of shaft (incomplete) ·12 mm., thickness ·008 mm.; length of rays ·031 mm., thickness ·0066 mm. Scopules somewhat similar to this fossil, but with more slender rays, are present in *Hexactinella ventilabrum*, Carter (see Chall. Rep. vol. xxi. pl. xcvi. figs. 7, 9).

Detached Spicules of Hexactinellid Sponges.

Pl. XV. fig. 27. Spicule with five smooth rays, the proximal ray straight and subcylindrical, whilst the transverse rays are slightly arched and tapering. The rays are traversed throughout by axial canals. Length of proximal ray ·235 mm., of transverse rays ·215 mm.

Pl. XV. fig. 28. Spicule with four stout equal rays in a plane, the rays curved slightly near the ends, which are obtuse and thickly set with minute spines or tubercles, the rest of the spicule smooth. Length of rays ·19 mm., thickness ·028 mm. Similar four-rayed spicules are present in recent species of *Hyalonema*; according to Schulze they occur in the basal pad of the lower portion of the body of the sponge. A similar form to this fossil, but larger, occurs in *Hyalonema tenerum*, Sch. (Chall. Rep. vol. xxi. p. 224, pl. xxxi. fig. 15), from the South Pacific, at a depth of 2550 fathoms.

Pl. XV. fig. 29. Spicule with four unequal rays in a plane; the rays of one axis are elongate, tapering, and acutely ended, whilst those of the other axis are shorter and somewhat obtusely ended. Except in the centre, the rays are set with short conical spines. The centre is slightly inflated. Length of the principal rays ·22 mm., of the shorter ·153 mm., thickness of the rays at the base ·028 mm.

Pl. XV. fig. 30. Spicule with six subequal, slender, slightly curved rays, which taper to an acute point and are covered with small spines. Length of rays ·095 mm., thickness ·01 mm.

Crateromorpha (c).—Pl. XV. fig. 31. Spicules with six (?) rays originally, two of them are now only represented by scars; the rays short, thick, and rounded at the ends. The axial canals are very distinctly shown. This form resembles the spicules of the stalk of *Crateromorpha Meyeri*, Gray (see Chall. Rep. vol. xxi. pl. 61. figs. 5, 6), from near Zebu, but it is much larger.

Pl. XV. fig. 32. Spicule probably six-rayed when complete, the rays slender with occasional large spines. Length of rays ·047 mm., thickness ·005 mm. Spicules similar in form but for the most part larger are present in *Semperella claviformis*, Gray (Ann. Mag. Nat. Hist. s. 4, vol. x. 1872, p. 76).

Pl. XV. fig. 33. Two slender five-rayed spicules, spined like the preceding. The spicules are in their natural position with respect to each other.

Mesh-Spicule of Hexactinellid Sponge.

Pl. XV. fig. 34. A fragment of spicular mesh of a Dictyonine hexactinellid in which the rays are minutely spined or tuberculate. Thickness of rays ·036 mm., distance from node to node ·22 mm. Small pieces of spicular mesh are common enough in the Oamaru material, but they are always mere fragments, hardly a single square being preserved entire. There is no apparent reason for this minute disintegration of the comparatively strong portion of the sponge-skeleton when one considers the perfect state of preservation of so many of the delicate flesh-spicules.

Anchoring-Spicules of Hexactinellid Sponges.

Pl. XV. fig. 22. An imperfect anchoring-spicule showing the distal end of the shaft with four openly curved, acutely pointed rays extending, grapnel-like, from it. Both shaft and rays traversed by axial canals. Width across rays 1 mm., length of rays ·75 mm., thickness of shaft ·1 mm. Anchoring-spicules of this type, but usually smaller than the form figured, are present in the recent *Euplectella aspergillum*, Owen (see Chall. Rept. vol. xxi. pl. iii. figs. 22, 23).

Pheronema (a).—Pl. XV. fig. 23. Spicule imperfect, consisting of the distal portion of a barbed shaft, which becomes thicker near the end and is harpoon-shaped with two prongs or rays, one of which is partially broken. The rays are smooth and recurve at an acute angle. The shaft has a wide axial canal, which at the end becomes bulbous, with a minute diverticulum at either side and one above. Length of head-rays ·078 mm., thickness of shaft ·017 mm. This spicule belongs either to the basal tuft or is one of those which project laterally from the surface of the sponge. Recent spicules of this type are much larger than the form figured, such as those of *Pheronema Annæ*, Leidy (see Chall. Rep. pl. xii. fig. 7), and of *P. Grayi*, Sav. Kent (Monthly Micros. Journ. 1870, p. 243, pl. 63. fig. 16), from the coast of Portugal.

Summary of Genera and Species of Hexactinellid Sponges in the Oamaru Deposit.

HEXACTINELLIDÆ.

No. of Species.

5 sp. *Hyalonema*, Gray.
1 sp. *Pheronema*, Leidy.
1 sp. *Caulophacus*, F. E. Schulze.
2 sp. *Crateromorpha* (?), Gray.
2 sp. Dictyonine genus (*Aphrocallistes* (?)).

As in the groups previously referred to, so also in this, only an approximate estimate of the genera and species present in the material examined can be obtained from the detached spicules. The species of *Hyalonema* and *Pheronema* have been determined from the amphidisc spicules, and to these genera may be referred the five-rayed pinule spicules (Pl. XV. figs. 5–9). The six-rayed pinules probably belong to one if not more species of *Caulophacus* or an allied genus. The large rosette-spicules represent two species of *Crateromorpha* or an allied genus. The only clue to the dictyonine sponges is furnished by the two forms of scopule flesh-spicules, which belong either to *Aphrocallistes* or an allied genus. The fragments of dictyonine mesh are too minute to give any indication of the genus or species to which they belong. Altogether 11 species and 5 genera appear to be represented.

So far as we are aware, no hexactinellid sponges, whether fossil or recent, have previously been recorded from the New-Zealand region. Even the 'Challenger' Expedition failed to find any in this area, for Prof. Schulze says:—"Neither on the South-east coast of Australia, nor on the voyage from Sydney to New Zealand, was there any sponge booty captured; but to the east of the North Island of New Zealand some Hexactinellid spicules at least were obtained, and near the Kermadec Islands as many as six different species" (Chall. Rept. vol. xxi. p. 432).

Spicules of unknown relationship.

Pl. VIII. fig. 32. Spicule almond-shaped, compressed, obtusely pointed at the ends, one side curved, the other nearly straight. The upper and under surfaces smooth, nearly flat. No canals shown. Length ·095 mm., width ·027 mm. These spicules are not uncommon in the material.

Pl. XIV. fig. 38. Spicule having the form of a delicate thin plate, elliptical in outline, with smooth margins, within this is a narrow band inclosing an ellipse with a slight central constriction; nearly in the longer axis of this figure is a short straight axial canal with a slight bead-like inflation near one end, and on either side of this a simple canal shorter than the central one. The inner band has a finely crimped exterior margin. Length of spicule ·105 mm., width ·06 mm. This is a rare form and its affinities are very doubtful.

General Summary.

As the result of our investigation of the material from Oamaru, we find that the probable number of genera and species of the different divisions of siliceous sponges, as represented by their detached spicules, is as follows:—

Monactinellid,	70	species and	24	genera.
Tetractinellid,	22	" "	9	"
Lithistid ..	7	" "	5	"
Hexactinellid,	11	" "	5	"

thus giving a total of 110 species and 43 genera which can be definitely recognized. These numbers in all probability fall far short of the real number present in these beds of siliceous rock, for account must be taken of the fact that only a mere handful of material has been so far examined, and this has been taken at random from the deposit, which, as already stated, is in one place from 40 to 60 feet in thickness. The number of species also would have been increased if an estimate could have been made of those whose skeletons only consist of the common types of larger spicules without distinctive flesh-spicules. These simple types of skeletal spicules, more particularly of Monactinellid sponges, are very abundant in the deposit, but they afford no data of the species or particular genus which they represent, and do not therefore appear in the summary. Nearly every hitherto known form of spicule of siliceous marine sponges, both skeletal and flesh-spicules, is represented in the Oamaru deposit, if we except some of those from Palæozoic strata and a few of recent sponges. Whilst the detached spicules appear for the most part to belong to still existent genera, the species, so far as can be determined from the flesh-spicules, are probably, with a few exceptions, distinct from recent forms.

A particular feature in the sponge-fauna of this Oamaru deposit is the remarkable preponderance in the number of genera and species of Monactinellid sponges over those of other groups. In the cases of sponge-beds in Cretaceous and Jurassic strata which have been hitherto investigated, the proportions have been reversed, and it might be said that Tetractinellid, Lithistid, and Hexactinellid spicules prevail almost exclusively, whilst those of Monactinellid sponges appear to be absent. This difference in the relative proportions of these groups is probably due to the fact that in the Oamaru deposit the minute and delicate spicules of Monactinellid sponges have been preserved equally as well as the larger and more resistant spicules of the other sponge-groups. Under similar conditions of preservation to those of the sponge-beds of the Cretaceous and older rocks, nearly all the Monactinellid spicules similar to those in the Oamaru deposit would have been rendered unrecognizable; and it is not unreasonable therefore to suppose that the absence of these sponge-spicules in the older rocks is rather due to their having perished in the fossilization, than that they did not co-exist with those other groups whose remains have been in part preserved.

The nearest existing relatives of many of the sponges in this New Zealand Tertiary deposit now inhabit the Indian and Southern Ocean, some are cosmopolitan in distribution, whilst others have as yet only been recognized in the North Atlantic and the Gulf of Mexico.

Another important fact is the association in this Oamaru deposit of sponge-remains, which, judging by their nearest living representatives, inhabit abyssal depths, with others, whose relations now exist in comparatively shallow water. Thus, for example, the deposit contains numerous spicules of the genus *Hyalonema*, recent forms of which, according to the 'Challenger' Report, usually occur in depths below 1000 fathoms, and range down to 3000 fathoms. There are also spicules belonging to such deep-sea Monactinellid genera as *Cladorhiza*, *Chondrocladia*, and *Esperiopsis*, species of which were met with by the 'Challenger' at depths from 1600 to 3000 fathoms. On the other hand there are, in the Oamaru deposit, spicules of such genera as *Myxilla*, which in recent seas are found in water not more than 10 fathoms deep, though some species occur at 600 fathoms, and of other genera both of Monactinellid and Tetractinellid sponges, which now inhabit depths from 10 to 200 fathoms. This association in the same deposit of the remains of what are apparently deep-sea and shallow-water sponges, may perhaps be explained by the fact that many genera have an extraordinary range of depth—thus *Hyalonema* ranges from 95 to 2900 fathoms, *Esperiopsis* from 30 to 1600 fathoms, *Cladorhiza* from 106 to 3000 fathoms; and it is highly probable that many Monactinellid genera now considered as only existing in shallow and moderately deep water will be found by further investigation to be equally capable of living in the same extreme depths as the more specially abyssal Hexactinellids. This finds confirmation in the 'Egeria' dredgings referred to already, which, though from depths of 2479 and 3000 fathoms, are filled with detached acerate, acuate, tibiella, and cylindrical spicules of Monactinellid sponges and flesh-spicules of such genera as *Esperella*, *Acarnus*, *Spirastrella*, and *Latrunculia*; some species of which now live at depths of 10–50 fathoms. This occurrence of supposed shallow-water sponges with deep-sea forms has already been commented on by Mr. H. J. Carter, who found in deep-sea dredgings off the Seychelle Islands associated with *Euplectella* the same forms of detached Monactinellid and other spicules which were present in dredgings from the Gulf of Manaar, between Ceylon and the southern extremity of India, at depths of 65 fathoms and under (Ann. & Mag. Nat. Hist. s. 5, vol. v. 1880, p. 439). It can hardly be alleged that the Monactinellid spicules in this and the other cases mentioned have been transported by currents from shallower areas, for we should then find sedimentary matter mingled with them as well.

Taking into account the close similarity in character of the Oamaru deposit with that of the recent diatom ooze in the Southern Ocean, the occurrence in it of the remains of deep-sea sponges, and the fact that similar detached spicules are now abundantly present in deposits from depths of 3000 fathoms off the S.W. of Australia, it may be assumed that these siliceous beds of Oamaru were formed at depths of not less than 1000–1500 fathoms, which is nearly the average depth of the similar deposits in the Southern Ocean, as ascertained by the 'Challenger' Expedition.

In conclusion we desire to express our obligations to Mr. H. Morland, Mr. B. W. Priest, Mr. Joseph Clark of Street, who have supplied us with many well-prepared microscopic slides of the material, and more particularly to Captain F. W. Hutton, from whom we received the first consignment of the Oamaru rock.

EXPLANATION OF THE PLATES *.

Plate VII.

Figs. 1, 2. Acerate spicules of *Reniera* or *Chalina*. × 200.
3–8. Acerate spicules of *Reniera* or *Chalina*. Figs. 3, 7, 8 × 200; fig. 4 × 100; fig. 5 × 300.
9, 10. Elongate acerate spicules. × 100.
11–13. Abruptly pointed acerate spicules. Figs. 11, 13 × 200; fig. 12 × 100.
Fig. 14. Fusiform tibiella spicule. × 200.
15. Spined acerate of *Halichondria*? × 200.
16. Spined acerate. × 300.
17. Verticillately spined acerate. × 200.
18. Spined acerate of *Halichondria*? × 200.
Figs. 19, 22. Curved spined acerates. × 200.
Fig. 20. Spined acerate. × 200.
21. Annulated acerate spicule. × 200.
Figs. 23–25. Acerate spicules with central inflation. Fig. 23 × 300; figs. 24, 25 × 100.
Fig. 26. Acerate spicule, with spines in centre, of *Alectona*? × 300.
27. Spined subcylindrical spicule. × 200.
28. Verticillately spined subcylindrical spicule. × 200.
29. Verticillately spined subcylindrical. × 200.
30. Spined cylindrical spicule. × 200.
Figs. 31–36. Smooth cylindrical spicules of *Reniera*? Figs. 31–35 × 200 fig. 36 × 100.
Fig. 37. Dumb-bell spicule of *Plocamia*. × 200.
38. Subcylindrical spicule, with spiral ridges, of *Dotona*? × 200.
39. Spined dumb-bell spicule of *Plocamia*. × 200.
40. Spined cylindrical spicule. × 200.
41. Spined acerate spicule. × 200.
Figs. 42, 43. Spined subcylindrical spicules of *Hymeniacidon*? × 100.
Fig. 44. Spined acerate spicule of *Alectona*. × 200.
Figs. 45, 47. Smooth cylindrical spicules of *Raspailia*? × 200.
Fig. 46. Smooth cylindrical spicule of *Reniera*? × 100.
Figs. 48–50. Smooth fusiform, tibiella spicules of *Myxilla*? Figs. 48, 49 × 100; fig. 50 × 50.
Fig. 51. Cylindrical spined spicule of *Plocamia*? × 200.
52. Vermiculate spicule of *Axinella*. × 200.

Plate VIII.

Fig. 1. Tibiella spicule of *Myxilla*? × 200.
2. Elongate tibiella spicule of *Forcepia*? × 200.
Figs. 3, 4, 5. Different forms of tibiella spicules. Fig. 3 × 100; fig. 4 × 200; fig. 5 × 300.
Fig. 6. Tibiella spicules with spined ends of *Iophon*? × 200.
7. Smooth acuate spicule. × 100.

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* To assist in the preparation of the Plates the Authors received a grant from the Royal Society, which they desire hereby to acknowledge.

Figs. 8, 9, 10. Different forms of acuate spicules. Fig. 8 × 50; fig. 9 × 200; fig. 10 × 100.
Fig. 10 *a*. Nearly cylindrical, abruptly pointed, acuate. × 100.
Figs. 11, 12. Smooth acuate spicules of *Myxilla*? × 100.
13, 14. Smooth curved acuate spicules. Fig. 13 × 100; fig. 14 × 200.
Fig. 15. Slender elongate acuate. × 200.
Figs. 16–20. Smooth comma-shaped acuates of *Axinella*? Fig. 16 × 100; figs. 17, 20 × 50; figs. 18, 19 × 200.
Fig. 21. Spined acuate spicule. × 200.
Figs. 22, 23. Straight fusiform acuates. × 100.
Fig. 24. Acuate spicule with spined head. × 100.
25. Spined straight acuate. × 100.
Figs. 26, 33. Curved spined acuates. × 200.
Fig. 27. Strongly spined acuate spicule. × 200.
28. Curved acuate with inflated summit. × 200.
29. Upper portion of spinulate spicule with knobbed summit. × 200.
30. Acuate spicule with curved summit. × 200.
Figs. 30 *a*, 31. Spined acuate spicules. × 200.
Fig. 32. Almond-shaped spicule. × 200.
34. Spined acuate spicule. × 200.
Figs. 35, 36. Elongate spined acuate spicules. × 100.
37, 37 *a*, 38. Spined pin-like spicules of *Hymeraphia*? Figs. 37, 38 × 300; fig. 37 *a* × 600.
39, 40. Smooth acuates with bulbous shafts. × 100.
Fig. 41. Smooth curved acuate. × 200.

Plate IX.

Fig. 1. Smooth pin-shaped spicule. × 100.
2. Pin-like spicule of *Suberites* (a). × 200.
3. Smooth pin-like spicule. × 50.
4. Pin-like spicule with spined head. × 200.
5. Pin-like, with strongly spined head. *Cribrella* (a). × 200.
Figs. 6, 7, 8. Smooth pin-like spicules of *Spirastrella*? Figs. 6, 8 × 100; fig. 7 × 50.
9, 10, 11. Curved pin-like spicules, Figs. 9, 10 × 200; fig. 11 × 100.
Fig. 12. Fusiform pin-like spicule of *Proteleia* (?). × 200.
13. Grapnel spicule of *Acarnus*, Gray. × 200.
14. Smooth pin-like spicule. × 100.
Figs. 15–18. Nail-shaped spinulates of *Hymeraphia* (?). × 200.
Fig. 19. Small, smooth, pin-like spicule. × 200.
Figs. 20, 21. Forceps flesh-spicules of *Forcepia Carteri*. Fig. 20 × 600; fig. 21 × 300.
Fig. 22. Forceps flesh-spicule of *Forcepia Vosmaeri*. × 600.
Figs. 23, 24. Tricurvate spicules of *Amphilectus* (?). Fig. 23 × 200; fig. 24 × 300.
25–29. Hook-shaped flesh-spicules of *Esperella* and other genera. Fig. 25 × 300; figs. 26–29 × 200.
Fig. 30. Hook-shaped spicule of *Cladorhiza* (?). × 200.

Figs. 31, 32. Hook-shaped flesh-spicules. Fig. 31 × 300; fig. 32 × 100.
33, 34, 37. Trenchant bihamate flesh-spicules of *Hamacantha Johnsoni* ?, Bowk. × 200.
Fig. 35. Trenchant bihamate flesh-spicule of *Hamacantha Huttoni*. × 200.
36. Bihamate spicule of *Hamacantha* (?), sp. × 200.
38. Flesh-spicule of *Melonanchora Morlandi*. × 200.
39. Equianchorate flesh-spicule of *Melonanchora* (a). × 300.
40. Equianchorate spicule of *Desmacidon* (a). × 600.
Figs. 41–44. Equianchorate spicules of *Myxilla* ? (a). × 300.
Fig. 45. Equianchorate spicule of *Myxilla* (c). × 600.
46. Equianchorate flesh-spicule of *Myxilla* (d). × 600.
Figs. 47, 47 *a*. Small equianchorates. Fig. 47 × 600; fig. 47 *a* × 300.
Fig. 48. Equianchorate spicule of *Myxilla* (b). × 600.
Figs. 49, 50. Lateral views of equianchorate spicules. × 600.
51, 52. Front and side view of equianchorate. × 300.
Fig. 53. Side view of equianchorate flesh-spicule. × 600.
Figs. 54, 55. Equianchorate spicules of *Myxilla*. Fig. 54 × 300; fig. 55 × 600.

Plate X.

Figs. 1, 2. Front and side views of palmate inequianchorate flesh-spicule of *Esperella* (a). × 200.
3, 4. Front views of inequianchorates of *Esperella* (b), (c). × 300.
5, 6. Slightly oblique views of palmate inequianchorates of *Esperella* (d), (e). × 300.
Fig. 7. Oblique view of small inequianchorate of *Esper lla* (l). × 300.
8. Front view of inequianchorate of *Esperella* (m). × 300.
Figs. 9, 10. Side views of small palmate inequianchorates of *Esperella*. × 300.
11–14. Different forms of inequianchorate flesh-spicules of *Esperella* (f), (g), (h), (i). × 300.
Fig. 15. Side view of palmate inequianchorate of *Esperella* (k). × 300.
Figs. 16, 17. Inequianchorate flesh-spicules of *Esperella* (n), (o). × 600.
Fig. 18. Side view of palmate inequianchorate of *Esperella* (p). × 600.
19. Palmate inequianchorate of *Iophon* (?). Side view × 300.
20. Side view of inequianchorate of *Esperella* (q). × 300.
21. Equianchorate flesh-spicule of *Myxilla* (e). × 300.
22. Side view of equianchorate spicule of *Myxilla* (f). × 600.
23. Navicular equianchorate spicule of *Esperiopsis* (a). × 300.
24. Equianchorate spicule of *Esperiopsis* (b). × 300.
Figs. 25, 26. Side and front views of equianchorate spicules of *Esperiopsis* (c). × 300.
27, 28, 29. Side and front views of equianchorate spicules of *Esperiopsis* (d). × 200.
Fig. 30. Equianchorate flesh-spicule of *Myxilla* (g). Side view. × 300.
31. Equianchorate spicule of *Chondrocladia* (a). × 600.
32. Side view of equianchorate of *Chondrocladia* (?). × 600.
Figs. 33, 34. Side and front views of equianchorate spicules of *Chondrocladia* (c). (d). × 600.
Fig. 35. Inequianchorate flesh-spicule of *Cladorhiza Haasti*. × 600.

Figs. 36, 41. Equianchorate flesh-spicules of *Desmacidon* (b). × 300.
Fig. 37. Equianchorate (?) spicule of *Chondrocladia* (e). × 300.
Figs. 38, 39. Front and side views of equianchorate spicules of *Desmacidon* (c). × 300.
Fig. 40. Side view of equianchorate spicule of *Halichondria* (a). × 300.
Figs. 42, 43. Side views of equianchorate spicules of *Halichondria* (b). × 600.
Fig. 44. Bipocillate (?) flesh-spicule of *Iophon hybridus*. × 600.
45. Spined equianchorate spicule. × 300. Side view.
Figs. 46, 47. Side views of equianchorate flesh-spicules of *Myxilla* (d). Fig. 46 × 300; fig. 47 × 600.
Fig. 48. Front view of equianchorate spicule of *Myxilla* (h). × 600.
Figs. 49–52. Front and side views of equianchorate spicules of *Myxilla Dendyi*. × 600.

Plate XI.

Figs. 1, 2, 3. Anchorate flesh-spicules of *Guitarra Carteri*. × 200.—Fig. 1 is a front view showing transverse striæ; fig. 2 shows the axial canal extending from one tubercle to the other; fig. 3 shows the outlines of the spicular shaft.
4–7. Anchorate flesh-spicules of *Guitarra intermedia*.—Fig. 4 is a specimen in which the front palms are absent, × 200. Fig. 5 is an oblique view showing the anterior palms; fig. 6 is a side view, × 200; fig. 7 is a side view of a much smaller specimen in which there are indications of canals in the anterior palms, × 600.
8, 9. Equianchorate spicules of *Pseudohalichondria deformis*. × 600.
Fig. 10. Equianchorate spicule of *Pseudohalichondria* (a). × 600.
Figs. 11, 14. Spined anchorate spicules of *Pseudohalichondria* (b). × 600. Side view.
12, 13. Oblique and side views of equianchorate spicules of *Pseudohalichondria Oamaruensis*. × 600.
Fig. 15. Sceptrella flesh-spicule of *Latrunculia* (a). × 300.
16. Sceptrella spicule of *Latrunculia* (b). × 300.
Figs. 17–23. Different forms of sceptrella spicules of *Latrunculia* (c), (d), (e), (f), (g), (h), (i). Figs. 17, 21, 22, 23 × 300; figs. 18, 19, 20 × 600.
24–28. Different forms of sceptrella flesh-spicules of *Latrunculia* (o), (p), (q), (r). Figs. 24–27 × 600; fig. 28 × 300.
29, 30, 31. Modified sceptrella spicules of *Latrunculia* (s). × 600.
Fig. 32. Sceptrella spicule of *Latrunculia obtusa*. × 300.
33. Sceptrella flesh-spicule of *Latrunculia* (t). × 600.
Figs. 34, 35. Elongate sceptrella spicules of *Latrunculia Oamaruensis*. × 300.
36–39. Different forms of sceptrella spicules of *Latrunculia* (k), (l), (m), (n). × 300.
Fig. 40. One of the whorls of a sceptrella, seen from above, showing the shaft and axial canal in section. × 600.
Figs. 41, 42. Nodose flesh-spicules of *Thoosa Hancocki*. × 600.
Fig. 43. Nodose flesh-spicule of *Thoosa Hancocki* (?). × 600.
44. Sceptrelliform flesh-spicule of *Alectona*. × 600.
45. Modified sceptrella of *Latrunculia* (u). × 600.

Plate XII.

Figs. 1, 2. Two forms of flask-shaped flesh-spicules of *Latrunculia* (v). × 600.
Fig. 3. Spined barrel-shaped flesh-spicule of *Thoosa* (a). × 600.
Figs. 4, 5. Spirular flesh-spicules of *Spirastrella* (a). × 600.
6, 7. Spirular flesh-spicules of *Spirastrella* (b), (c). × 600.
8, 8 *a*. Spirular flesh-spicules of *Pronax* (a). × 300.
Fig. 9. Spined spirular spicule of *Pronax* (b). × 600.
10. Candelabrum spicule of *Corticium* with inflated head-rays. × 600.
11. Smaller candelabrum with similar head-rays to fig. 10. × 600.
12. Candelabrum spicule of *Corticium* (b) with obtusely-pointed head-rays. × 600.
Figs. 13, 13 *a*, 14, 15. Candelabra spicules of *Corticium* (b) with mitre-like summits and varying number of basal rays. × 600.
Fig. 16. Candelabrum with quadripartite head-rays of *Corticium* (c). × 600.
17. Candelabrum with simple head-rays of *Corticium* (d). × 600.
Figs. 18, 19. Candelabra spicules, with extended basal rays, of *Corticium* (e). × 600.
20, 21. Candelabra spicules of *Plakina australis*. × 600.
22, 23, 24. Modified stellate spicules of *Corticium* (?). Figs. 22, 23 × 600; fig. 24 × 300.
25, 26, 27. Modified small calthrops spicules of *Corticium*. Figs. 25, 27 × 300; fig. 26 × 600.
28–32. Modified calthrops (?) spicules of *Corticium* (?). Figs. 28, 30 × 300; figs. 29, 31, 32 × 600.
Fig. 33. Small globostellate, with spined truncate rays, of *Stelletta* ? × 600.
Figs. 34, 35. Trifid spicules of *Ditriænella Oamaruensis*, n. g. et sp. × 200.
Fig. 36. Trifid spicule of *Ditriænella* (a). × 600.
37. Spined calthrops spicule of undetermined sponge. × 600.

Plate XIII.

Figs. 1, 2. Fusiform acerate spicules of *Geodites* and *Stelletta*. × 20.
3, 4, 5. Trifid skeletal spicules of *Geodites* (a). × 20.
6, 7, 8. Different forms of trifid spicules of *Geodites* (b). Fig. 6 × 20; figs. 7, 8 × 40.
9, 10. Trifid skeletal spicules of *Stelletta* (a). Fig. 9 × 20; fig. 10 × 40.
11–15. Different forms of trifid spicules of *Geodites* or *Stelletta*. Fig. 11 × 50; figs. 12–15 × 20.
16, 17. Forked trifid spicules. Fig. 16 × 50; fig. 17 × 20.
Fig. 18. Anchor trifid spicule of *Thenea* (a). × 100.
19. Anchor trifid spicule of *Geodites* (a). × 20.
Figs. 20–24 *a*. Different forms of anchor trifid spicules. Fig. 20 × 20; fig. 21 × 40; fig. 22 × 100; figs. 23, 24 × 50; fig. 24 *a* × 200.
25, 26, 27. Different forms of lithistid skeletal spicules of *Lyidium* (a). × 40.

Figs. 28, 29, 30. Different forms of skeletal spicules of Tetracladine lithistids. × 50.

31, 32, 33. Different forms of skeletal spicules of Anomacladine lithistid, *Vetulina Oamaruensis*. × 200.

Fig. 34. Modified trifid spicule of *Triptolemus australis*. × 40.

Figs. 35–40. Different forms of calthrops spicules of *Pachastrella*. Figs. 36, 38, 40 × 40; fig. 35 × 100; figs. 37, 39 × 200.

Plate XIV.

Figs. 1, 7. Trifid spicules of the dermal layer of lithistid sponges. *Corallistes* (a). Fig. 1 × 200; fig. 7 × 50.

2, 3, 5. Modified trifid spicules of the dermal layer of *Discodermia* (a). × 40.

Fig. 4. Modified trifid spicule of the dermal layer of *Theonella* (a). × 40.

6. Dermal spicule of *Corallistes* (?). × 40.

Figs. 8–11. Different forms of lithistid dermal spicules of *Discodermia*. × 100.

Fig. 12. Dermal spicule of *Discodermia sinuosa*. × 100.

Figs. 13, 14. Modified dermal spicules in which each of the head-rays is trifurcate, genus undetermined. × 200.

15, 16. Stellate spicules of *Stelletta* (d). × 300.

17, 20, 22, 24. Globostellate spicules of *Tethya* (a). Figs. 17, 20 × 100; figs. 22, 24 × 300.

18, 18 *a*, 21. Small globostellate spicules of *Geodites* (?). × 600.

Fig. 19. Globostellate spicule. × 200.

Figs. 23, 31. Small globostellates of *Pachastrella* (a). × 600.

25, 26, 27. Stellate spicules with spined rays. Figs. 25, 26 × 200; fig. 27 × 600.

28, 29, 30. Globostellate spicules with truncate and spined rays of *Stelletta* (b). × 200.

32, 32 *a*. Globate spicule of *Geodites*. × 200.—Fig. 32 *a*. A portion of the surface of fig. 32, still more enlarged, showing the spined heads of its minute component spicules. × 600.

33, 34. Two forms of discoidal spicules of *Erylus* (a), (b). × 200.

35, 36, 37. Dermal spicules of unknown sponge, *Dactylocalycites*, Carter. × 200.

Fig. 38. Dermal (?) spicule of unknown sponge. × 200.

Plate XV.

Fig. 1. Spined acerate spicule of Hexactinellid. × 200.

Figs. 2, 3, 4. Different forms of six-rayed pinule spicules of *Caulophacus* and allied genera. × 200.

Fig. 5. Short truncate pinule with five rays. × 600.

Figs. 6, 7, 8, 9. Different forms of five-rayed pinule spicules of *Hyalonema* and allied genera. Figs. 6, 7, 8 × 200; fig. 9 × 100.

10, 11. Two forms of rosette spicules of Hexactinellid. × 300.

Figs. 12, 13. Two forms of rosette spicules of *Crateromorpha* (a), (b). × 200. Many of the rays in these spicules are imperfect, having been broken away.

Fig. 14. Amphidisc spicule of *Hyalonema* (a) with four rays. × 100.

Figs. 15, 16. Two forms of amphidisc spicules of *Hyalonema* (b), (c). × 200.

Fig. 17. Amphidisc spicule with eight elongate rays at each end, *Hyalonema* (d). × 200.

Figs. 18, 19, 20. Different forms of amphidisc spicules of *Hyalonema* (e), (f), (g). Figs. 18, 20 × 100; fig. 19 × 300.

Figs. 21, 26. Small amphidisc spicules. Fig. 21 × 200; fig. 26 × 300.

Fig. 22. Distal end of anchoring-spicule of Hexactinellid. × 20.

23. Distal end of anchoring-spicule of *Pheronema* (a) with barbed shaft and harpoon-like head. × 200.

24. Upper portion of scopule spicule of *Aphrocallistes* (a). × 300.

25. Portion of shaft and rays of scopule spicule. × 300.

27. Detached five-rayed spicule of Hexactinellid. × 200.

28. Detached four-rayed spicule of *Hyalonema*. × 100.

29. Spined four-rayed spicule. × 100.

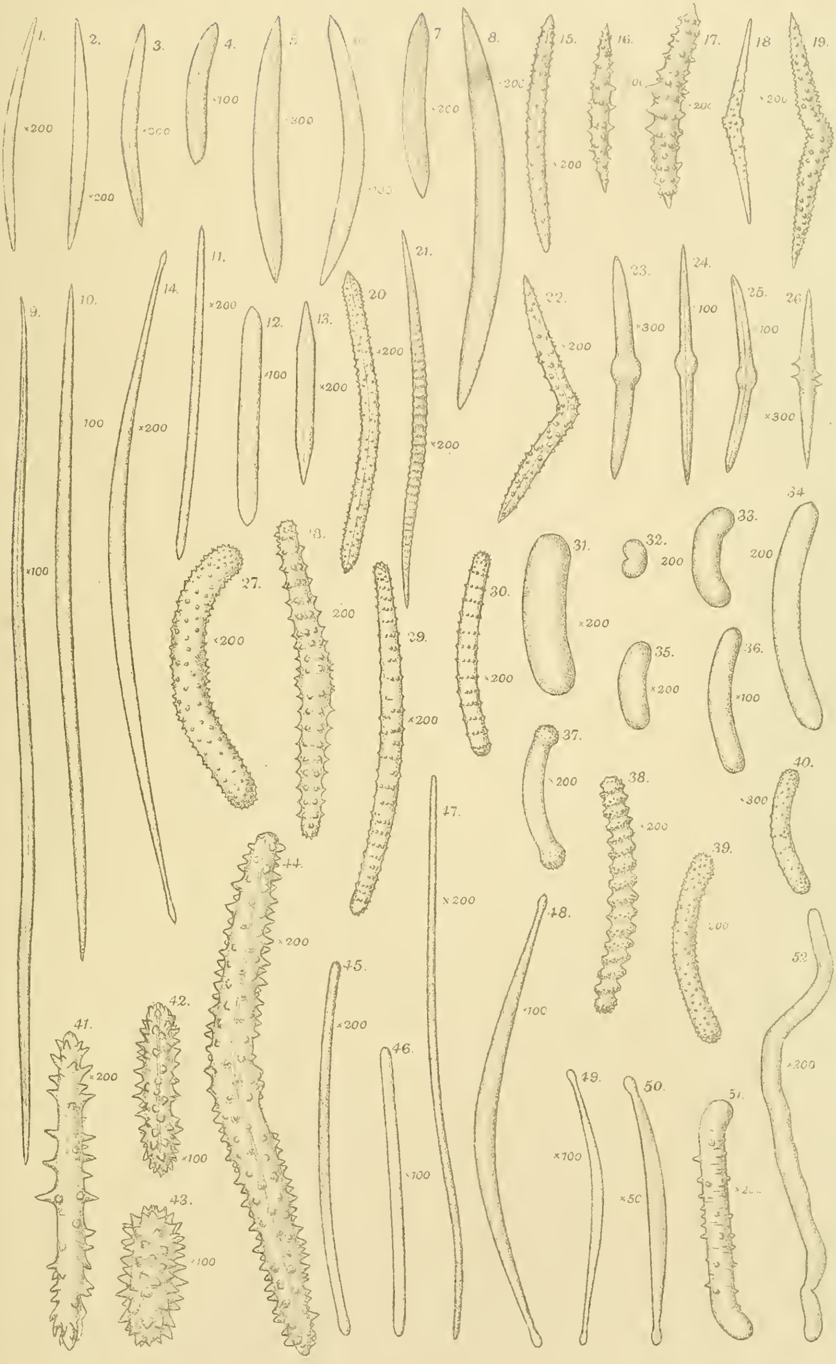
30. Slender spined six-rayed spicule. × 200.

31. Six-rayed spicule of *Crateromorpha* (c). × 100.

32. Slender six-rayed spicule with prominent spines. × 200.

33. Slender five (?)-rayed spicules in their natural position with respect to each other. × 200.

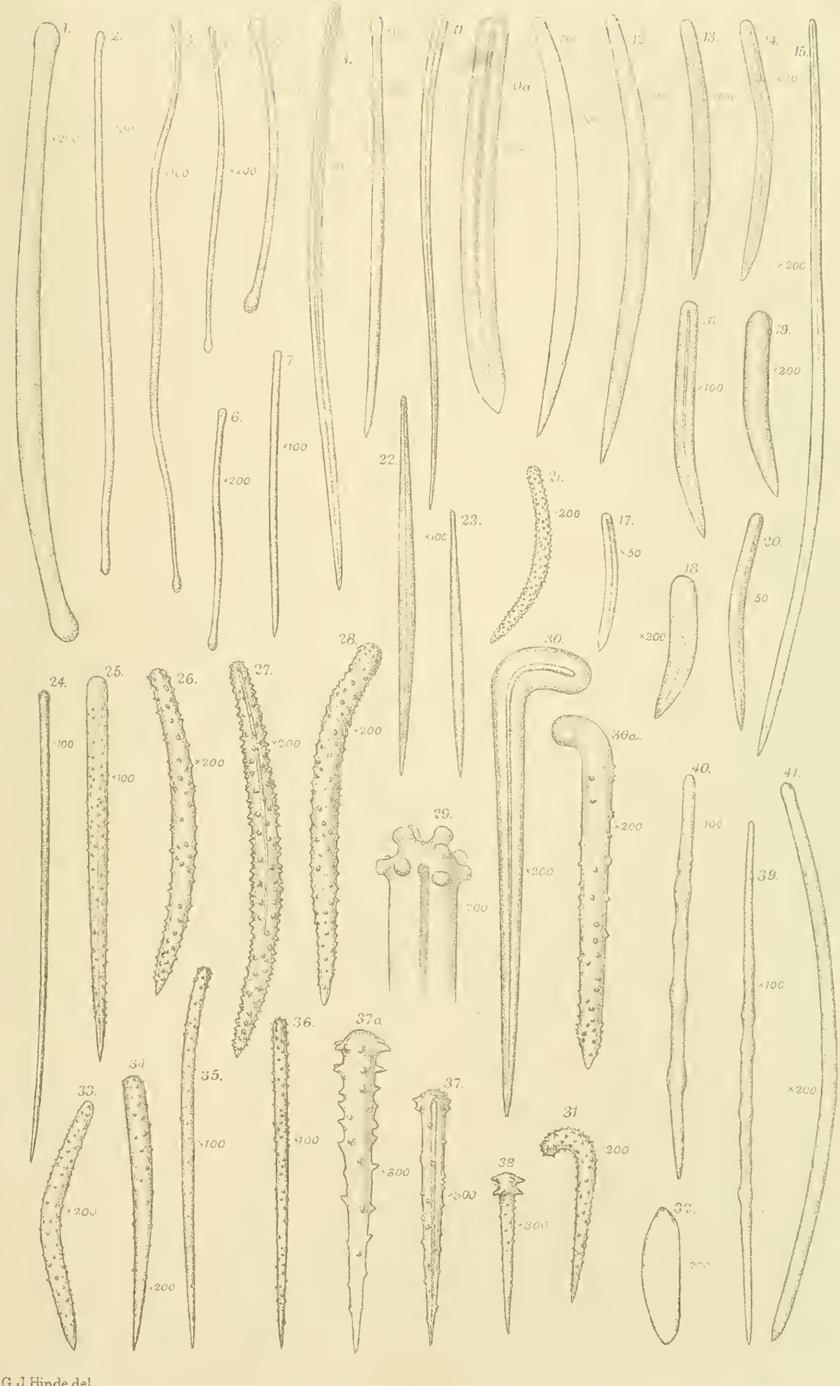
34. Fragment of spicular mesh of dictyonine Hexactinellid. × 200.



G.J.Hinde del
A.T.Hollick lith.

West, Newman lith.

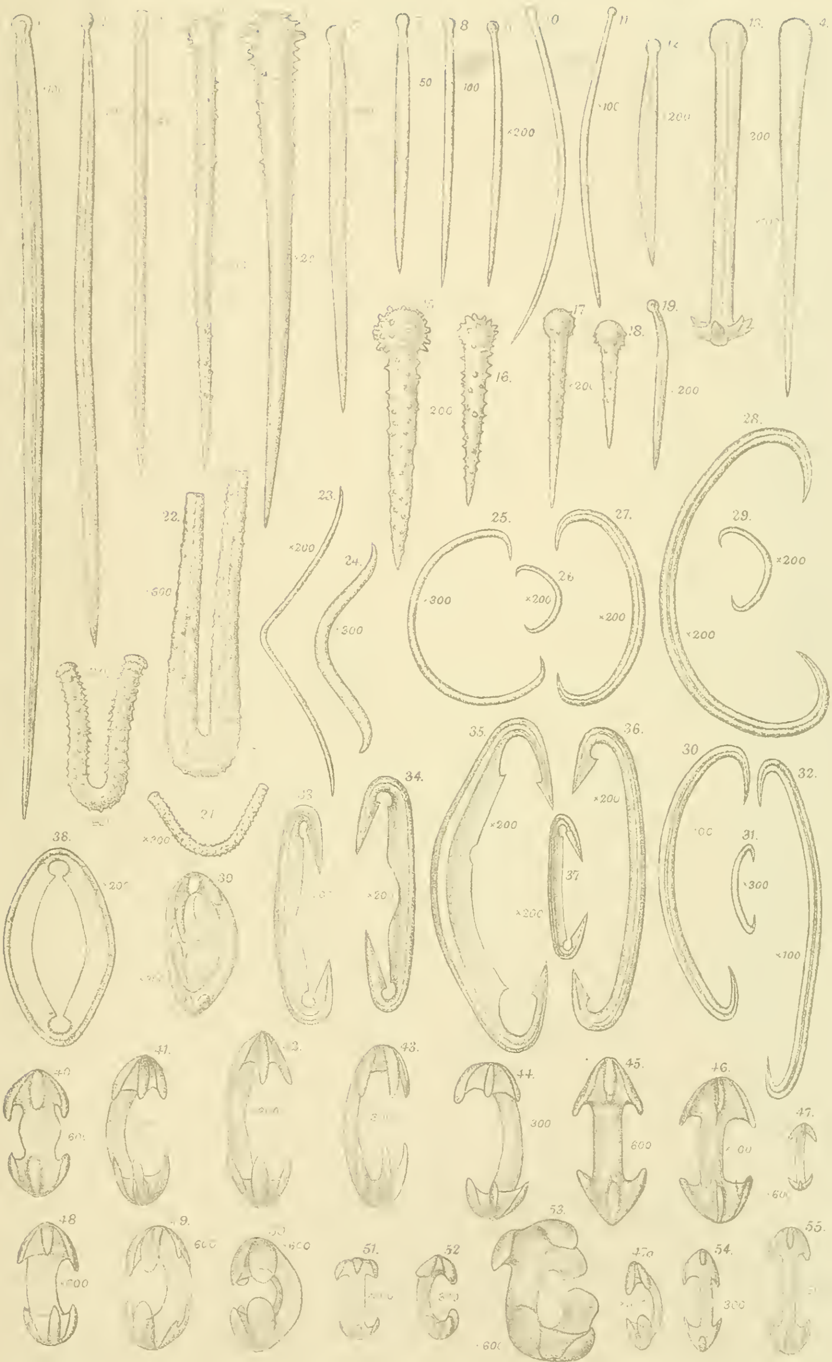
FOSSIL SPONGE SPICULES - NEW ZEALAND.



G. J. Hinde del.
A. T. Hollick lith.

West Newman lith.

FOSSIL SPONGE SPICULES - NEW ZEALAND.



G. J. Hinde del.
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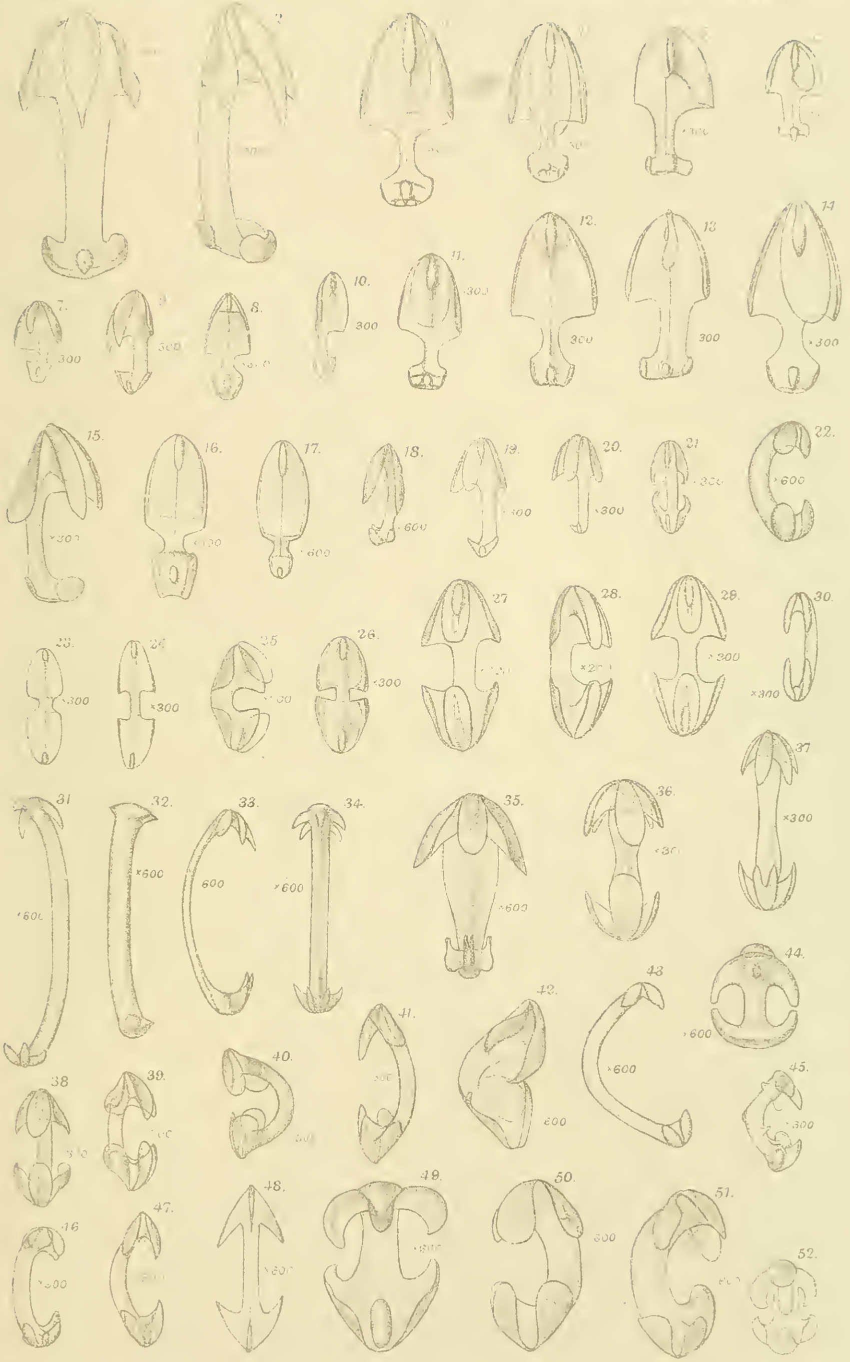

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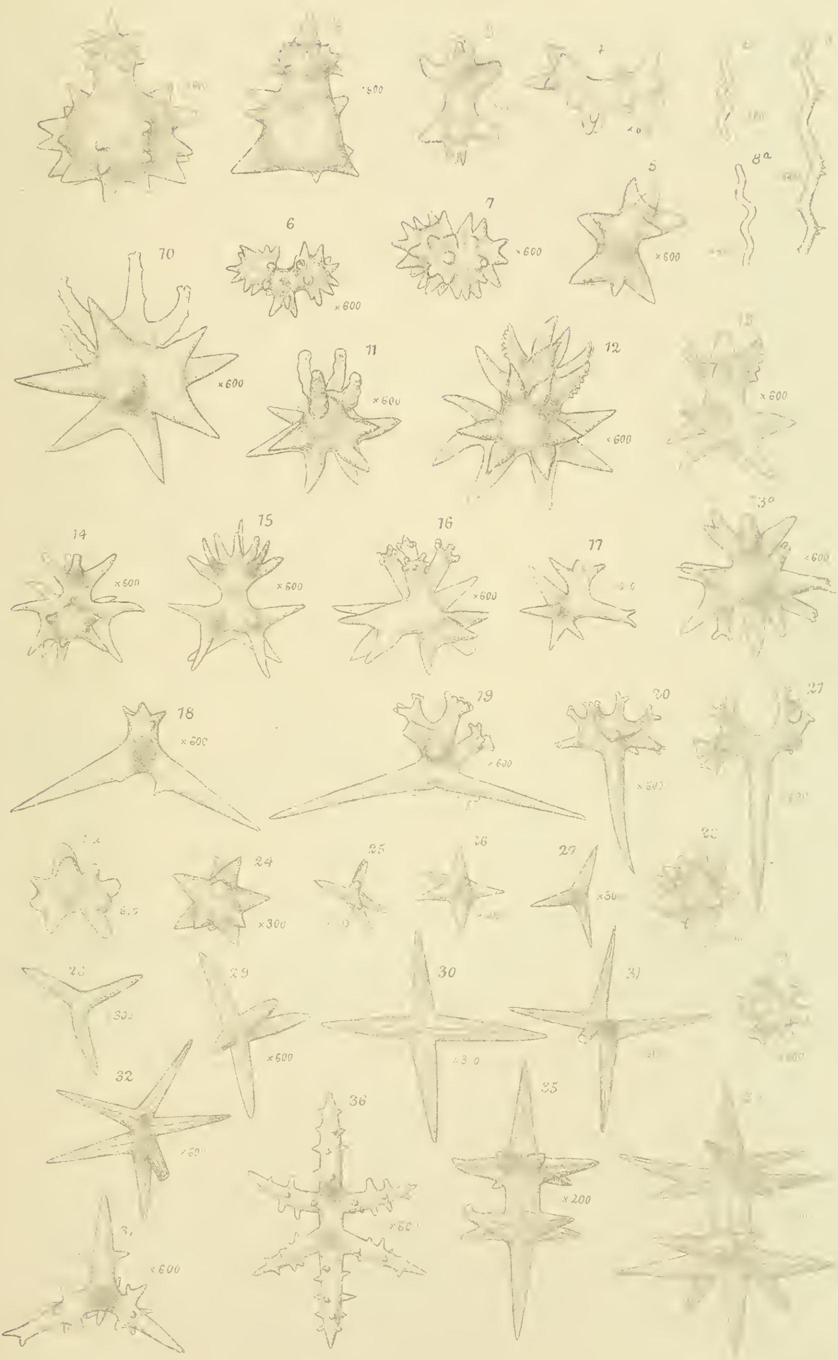

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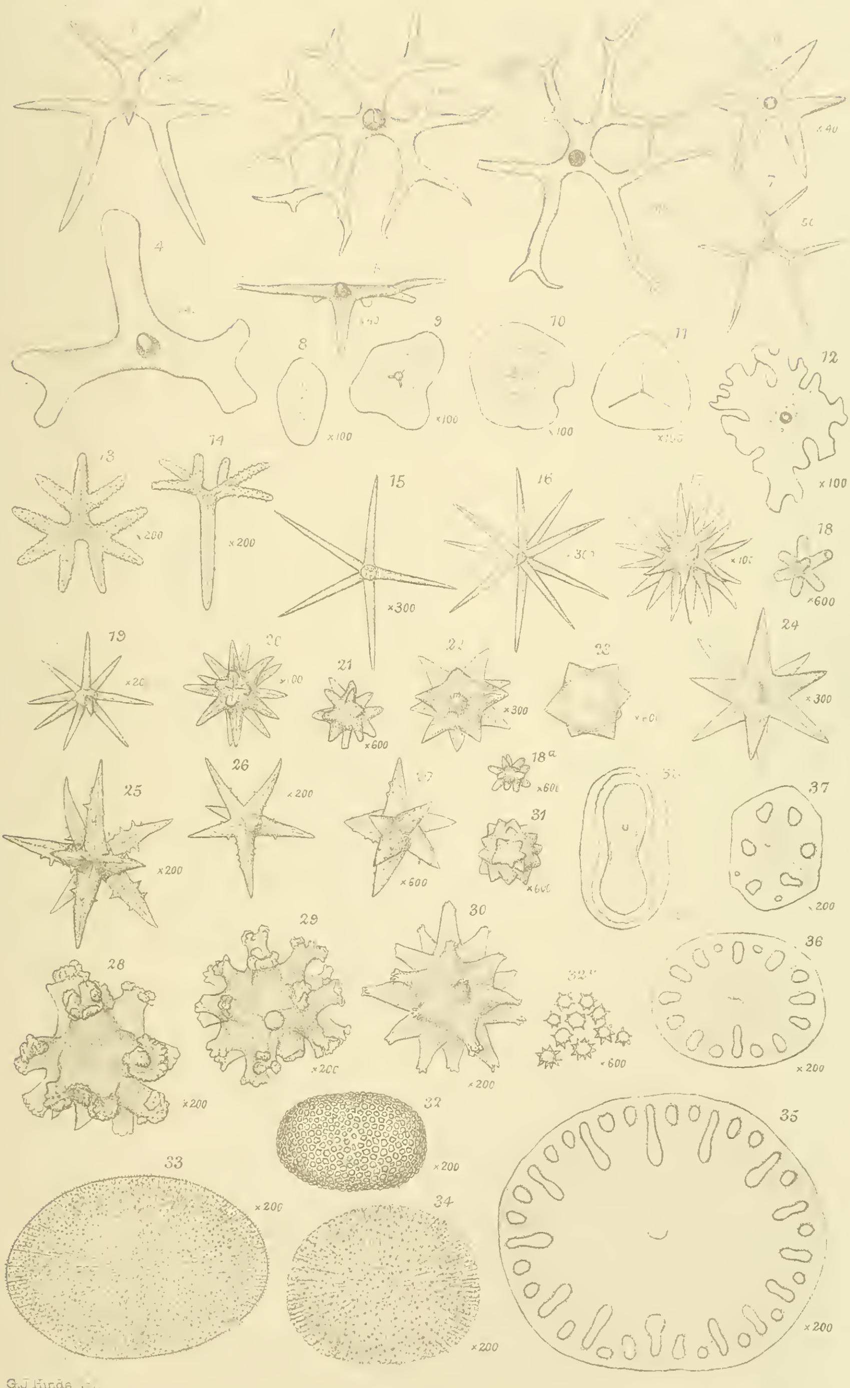

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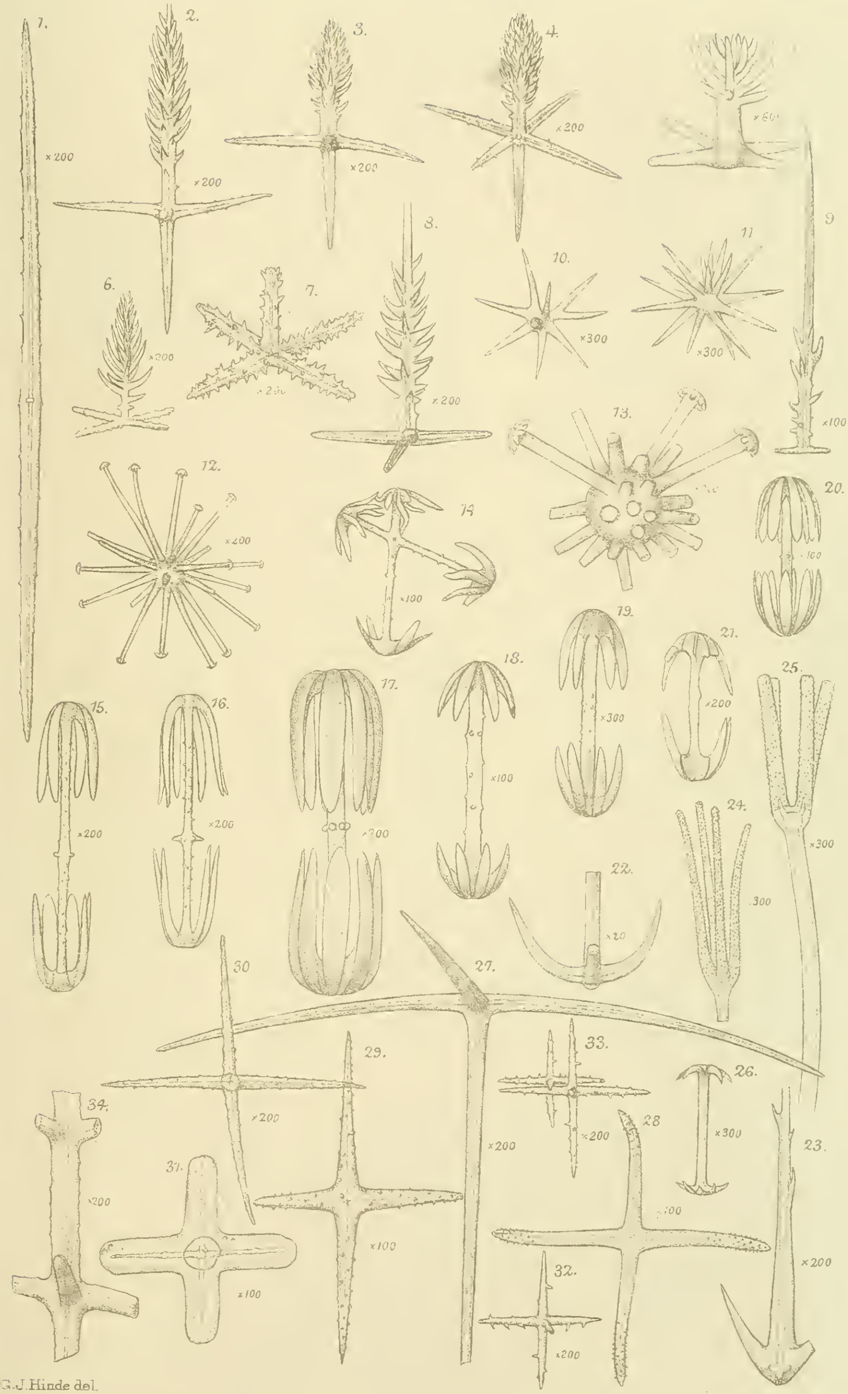

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