

ON THE SPECIES  
OF  
ECHINOIDEA

DESCRIBED BY

LINNÆUS

IN HIS WORK

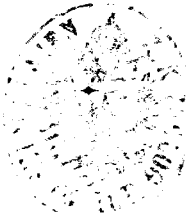
MUSEUM LUDOVICÆ ULRICÆ.

BY

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WITH NINE PLATES.

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## I.

### The Museum Ludovicæ Ulricæ.

The middle of the eighteenth century may be said to mark an epoch in the life of LINNÆUS. During the years that had elapsed since JOHN FREDERIC GRONOVIVS, in Leyden 1735, when returning the first visit of the young foreigner then fresh from the north, was shown the manuscript of the *Systema Naturæ*, and struck with admiration, conjointly with »a learned Scotchman ISAAC LAWSON», undertook its publication, the author had devoted all his energies to the development of the germs that »*conspectus*» comprehended. In several works of great importance he had already laid the foundations of systematic botany, had explored the principal parts of his native land, had given it a Flora and a Fauna, and, while attending in an exemplary manner to professorial duties which embraced a vast field of learning and research, lectures followed with intense interest, excursions and demonstrations, discourses and dictations, the outcomes of which have been brought down to us in numerous academical dissertations, had formed a school of gifted and zealous naturalists such as the world has rarely seen before or since. And now the most significant period of his life had arrived. That Nature's System of which in early manhood, when yet on the threshold of science, he had sketched the outlines, and which had since appeared in two editions, revised and enlarged though kept within the primitive plan, now demanded to come forth as the great achievement of his life, in an »*editio reformata*», embracing every species known within the three Kingdoms of Nature. The plants, his first love, claimed the first of his efforts, and he again applied all his powers to the *Species Plantarum*, which in 1748 he had begun and brought a long

way, and now resumed from the beginning, while materials in marvellous abundance poured in from all parts to his far-famed study at Upsala. At the same time the long-meditated design of freeing the morphological nomenclature from the cumbrous burden of the »nomen specificum», always subject to losing in distinctiveness through the continual discovery of new species, stood forth in all its urgency, and the master in the art of describing, after years of consideration, in laying down its rules resolved on another mode of naming species, at once simple, constant and universally applicable, and destined almost alone to inaugurate a new science. The *Philosophia Botanica*, the crowning development of the *Fundamenta* of 1736 and the *Critica* of 1737, went to the press in the month of September 1750 and was published in the beginning of the following year.

A few months later ADOLPHUS FREDERIC, of the House of Holstein-Gottorp, and LOUISA ULRICA, a younger sister to FREDERIC of Prussia, succeeded to the throne of Sweden. Following a fashion then in vogue among crowned heads they desired to see their royal residences adorned by cabinets of curiosities and collections of natural history, and two of their country-palaces were each to receive a Museum. At Ulriksdal, to the north of the capital, the King's Museum was established, chiefly consisting of Vertebrates, while the Queen's Museum, comprising Insects, Crustacea, Shells, Echinoderms and Corals, was formed in her palace Drottningholm, on the lake Mälaren. Some beginnings of a collection, made by Queen ULRICA ELEONORA the younger, sister to CHARLES the twelfth, are said to have existed there previously.<sup>1)</sup>

In those days Holland was the land of Museums, where the wealthy and educated of all classes vied with each other in possessing the choicest among the many rarities that poured in from all parts of the then known world, from Amboina near its eastern limit as well as from Curaçao and Surinam in the far west.<sup>2)</sup> »Her Majesty», said LINNÆUS in his enthu-

<sup>1)</sup> OLOF SWARTZ, *Tal om Naturalhistoriens upphof och framtid i Sverige* (On the rise and progress of Natural History in Sweden), Read to the R. Acad. of Sciences on the 8th of Sept. 1790. Stockholm 1794, p. 40. This collection is said to have been originally formed at Ulriksdal.

<sup>2)</sup> *Tout le monde le doit céder aux Hollandais* says D'ARGENVILLE in his review of the principal cabinets of Europe, *Conchyliologie*, ed. 1742, p. 214. — See also VALENTYN, *Beskr. v. Oostindien*, Amsterdam 1726, III, II, p. 560.

siastic way when lecturing on the Testacea in 1752, »possesses a cabinet of shells that surpasses every other in Europe. Its foundation was laid when Her Majesty acquired the choice collection of a high functionary at Amsterdam who had spent all his life in forming it», and this »together with four or five later additions, has become a truly matchless collection»<sup>1)</sup>. On these acquisitions some details are found in the accounts, still extant, of expenses paid from the privy purse of the Queen in the years 1750—1752, kept by the Marshal of Her Household Count CHARLES GUSTAVUS TESSIN, the stanch and generous friend of LINNÆUS, and himself an excellent judge in matters of learning and taste. The first entry relating to the Museum is the payment, on the 13th of November 1750 and the 15th of January 1751, of the sum of 11475 Dollars Copper to the widow of one M. SCHOTT<sup>2)</sup> at Utrecht. It is followed in the same year by the acquisition from out property left by one M. KATEN,<sup>3)</sup> of shells and »natural curiosities» for a sum of 4189 Dollars, and by a lot of »butterflies, insects, miniatures and books» worth 4619 Dollars. In the month of March 1752 PIERRE BALGUERIE, the Swedish Consul at Amsterdam, reports that a rich collection of shells, minerals, petrefactions, insects, from all parts of the world, filling ten cabinets, formerly the property of the renowned SEBA, and estimated to fetch the sum of fifty thousand Guilders, were to be sold by auction on the 14th of April, and receives orders to make purchases for the King and the Queen to the amount of four thousand Guilders. From this sale objects for a sum of 3612 Copper-Dollars were added to the Queen's cabinet<sup>4)</sup>, while the rest went to the King's Museum and to that of Count TESSIN. In April 1752 another collection of shells is received<sup>5)</sup>, and during that same year the outcomes arrive of KALM's voyage to North America and OSBECK's to China, as

<sup>1)</sup> See also L. to WARGENTIN, <sup>23</sup>/<sub>11</sub> 70, in ÄHRLING, CARL VON LINNÆUS Svenska Arbeten, I, p. 418, and Egenh. Ant., p. 50.

<sup>2)</sup> Possibly the JAKOB ELIAS SCHOTT of Amsterdam enumerated by VALENTYN l. c. among the great collectors. The name is not mentioned by D'ARGENVILLE, l. c. ed. 1742 and 1757, but in the third ed., 1780, I, p. 337, is said, under Utrecht: »La collection de M:r SCHVTE (sic), D:r en Méd., regarde particulièrement les cocquilles». Perhaps a son of the former, whose widow may have removed from Amsterdam to Utrecht.

<sup>3)</sup> Mentioned by VALENTYN l. c. as possessor of a large collection.

<sup>4)</sup> The Copper-Dollar of 1750 being worth 0,40 Crown in the present Swedish money, these four Dutch items make in all 9558 Crowns, £ 530.

<sup>5)</sup> Entry of <sup>6</sup>/<sub>4</sub> 52.

well as North American specimens from GARDEN<sup>1)</sup>). A considerable collection of Swedish insects is presented by HARTMAN<sup>2)</sup>, another, of fishes, plants and shells by HOLM, Swedish Consul, at Marseille<sup>3)</sup>; and an «ingens collectio», from China by LAGERSTRÖM, Director of the Swedish East India Company at Gotenburg, this to be divided between the Queen's Museum, and that of LINNÆUS<sup>4)</sup>). The Queen on the solicitation of BÄCK, redeemed at an expence of 14000 Dollars, Copper for the collections made in Egypt and Palestine by HASSELQUIST<sup>5)</sup>. Valuable additions were also received from Surinam and the West Indies through DALBERG<sup>6)</sup>, from Montpeiller through GOUAN in 1758, from the Cape of good Hope through RICH. TULBAGH<sup>7)</sup> in 1763. Through these acquisitions, and doubtless others of which no record is extant, the two Royal Museums must have become for those days very considerable. LINNÆUS never failed to extol their value. To him, who had at his own command but a small supply of specimens out of lower classes of the Animal Kingdom, the Museum of the Queen was the principal source of information with regard to exotic Insecta, Vermes and Zoophyta. Without it he never could have effected as successfully, as he did, his great scheme of the Systema Naturæ of 1758, and it may be allowable to suppose that his enlightened friend Count TESSIN, when in later years he was blamed for having squandered the Queen's money on the whim of a Museum, found some solace in recollecting that he had

<sup>1)</sup> ALEXANDER GARDEN of Charleston. Egenh. Ant., p. 86.

<sup>2)</sup> L. to BÄCK, <sup>13</sup>/<sub>11</sub> 53. The Archiater ABRAHAM BÄCK, LINNÆUS' dearest, most faithful and confidential friend at whose house, as if he were his own brother, he used to stay, through all his life, whenever he was in Stockholm, b. 1713, d. 1795. He was created M. D. at Upsala in 1740 and visited during five years the principal Medical Schools of Europe, chiefly Leyden and Paris. In 1745 he became a fellow of the Swedish College of Physicians, in 1752 its President and Head Physician of the Seraphim Hospital, the foundation of which was his work in conjunction with OLAUS ACREL, the eminent Surgeon. LINNÆUS named a genus of the Myrtaceæ Bäckia in honour of his friend. — BÄCK's large collection of letters from LINNÆUS is in the library of the Academy of Sciences. Compare Eg. Ant. p. 52, 67.

<sup>3)</sup> L. to BÄCK, <sup>14</sup>/<sub>5</sub> 54.

<sup>4)</sup> L. to BÄCK, <sup>1</sup>/<sub>6</sub> 54. LINNÆUS presented his own share to the Museum Academiæ Upsaliensis: Instructio Musei, Amæn. Acad. III, p. 458.

<sup>5)</sup> Deceased near Smyrna <sup>3</sup>/<sub>2</sub> 52; Egenh. ant. p. 181. — L. to WAHLBOM <sup>8</sup>/<sub>12</sub> 52, in ÅHRLING l. c. — L. to WARGENTIN, <sup>22</sup>/<sub>4</sub> 52. — ÅHRLING, LINNÆUS and his disciples, in: Festen till CARL v. LINNÆS minne, (Commemoration of LINNÆUS), Upsala, 1878, p. 72.

<sup>6)</sup> L. to BÄCK, <sup>29</sup>/<sub>9</sub>, <sup>1</sup>/<sub>10</sub>, 54, C. G. DALBERG, formerly an Officer in the Army, had lived some years in Surinam.

<sup>7)</sup> General, Dutch Governor of the Cape Colony. Egenh. Ant. p. 55, 195.

done so, seemingly, to follow the fashion of the day, but in reality just as much for the sake of science and LINNÆUS. And long after he had fallen into disgrace and poverty and had retired to the solitude of Åkerö, the author of the *Systema Naturæ* publicly proclaimed, in words even more glowing than before, his unfailing gratitude towards his once powerful patron.<sup>1)</sup>

As early as 1751 LINNÆUS had been invited to arrange the royal collections on which two descriptive illustrated works were to be published under his authorship. It seems as if this plan had been laid aside for some time in consequence of a great fire which at the end of May destroyed a considerable part of the southern suburbs of the capital and caused great distress, for in June LINNÆUS asks his friend BÄCK<sup>2)</sup> to let him know whether the Royal Couple had altered their design. But soon afterwards, in the beginning of July, we find him installed and at work in the Queen's Museum at Drottningholm,<sup>3)</sup> with a valuable set at hand of the best works of that period on Natural History. He staid there till the end of the first week of September. An intended visit in October »to see two grand sights at once, namely the coronation and the new *Papiliones*»<sup>4)</sup>, was prevented by a severe attack of hemicrany<sup>5)</sup>, and he remained at his home in Upsala hard at work on the *Species Plantarum*, the copying of the »*Museum Reginae*», and writing the »*Plantæ Hybridæ*»<sup>6)</sup>. Having »presided» over the ventilation of this dissertation he »sailed» on the lake Mälaren to Stockholm, and staid there, as usual at BÄCK's house, about a week, during which he seems to have been at Drottningholm on a short visit only, as the two costly insect-cabinets of American cedar<sup>7)</sup> were not yet fi-

1) See P. H. MALMSTEN, *Minnesord öfver CARL VON LINNÉ*, vid Kongl. Vetenskaps-Akademiens sammankomst d. 10 Januari 1878. (To the memory of LINNÆUS, address to the R. Swedish Acad. of Sciences, Jan. 10, 1878.)

2) L. to BÄCK, 18/6 51.

3) »In 1751 the *Museum Reginae* was described at Drottningholm» Egenh. Anteckningar, p. 2, p. 50. — L. to BÄCK 7/7, 10/9 51.

4) Just arrived from Holland; entry into the accounts 24/9 51.

5) L. to Count TESSIN and to BÄCK, 27/9, 30/9 51.

6) Ventilated 23/11 51, respondente JOH. HAARTMAN. *Amœnitates Academicæ*, III, p. 28.

7) *Instructio Musei*, *Dissertatio*, 14/11 53, *Amœnitates Academicæ*, III, p. 456. — On 13/4 52 the joinery of the two cabinets was paid for with 4500 Dollars Copper = 1890 Crowns (£ 105), perhaps even exclusive of the wood, there being an entry on the 16/12 51 for »*bois de Cèdre*». The



nished. Towards the end of January 1752 he is just returned to Upsala from the capital. After two months of hard work on the Species Plantarum, with lecturing and other professorial duties, he is again summoned to court, but through the intercession of BÄCK obtains leave to take some rest and recover from an attack of peripneumonia, which had brought him very low.<sup>1)</sup> It is not until the beginning of August that he is at work again at Drottningholm; and on the eighth of September he is back at Upsala. About the middle of December<sup>2)</sup> he is summoned to Ulriksdal, and there he remains during six weeks describing the King's cabinet.<sup>3)</sup> In the following year, 1753, he is preparing the Museum Regis for the press; sees to the printing of the Species Plantarum, and asks permission to stay away from Drottningholm during the summer. In August an intended visit there is prevented by the small-pox being prevalent.<sup>4)</sup> In 1754 he is at Ulriksdal during Whitsuntide from the 2d to the 13th of June, and at Drottningholm from the 20th of July to the 5th of August, as also from the 28th of that month to the 10th of September, this time arranging the herbarium of HASSELQUIST.<sup>5)</sup> About the end of September he is there again to see the American collections presented by DALBERG, and from the 2d to the 9th of November at Ulriksdal working at the King's cabinet. In the following year, 1755, he is summoned to court on Museum business on the 12th of February, and seems to have been there a second time in the month of March.<sup>6)</sup>

It may be presumed that the life at court was not allowed by LINNÆUS to interfere with his daily habits<sup>7)</sup>; and that the early daybreak of the Swedish summer found him at his wor-

cabinets still exist at Upsala and now contain the numismatic collection of the University.

<sup>1)</sup> L. to BÄCK,  $^{10}/_7$  52; to WARGENTIN,  $^{14}/_7$  52, ÄHRLING l. c. p. 270.

<sup>2)</sup> »On the 19th or 20th of December I shall be at Stockholm. See that you restore H. Majesty to health again, that we may go together to Ulriksdal.» L. to BÄCK,  $^{11}/_{12}$  52.

<sup>3)</sup> L. to WAHLBOM,  $^{12}/_2$  53. — »In 1753 the King's Museum was described.» Egenh. Anteckn. p. 2.

<sup>4)</sup> L. to BÄCK,  $^8/_8$  53. In July 54, however, he writes that he had been at Drottningholm in August 53.

<sup>5)</sup> L. to BÄCK,  $^{1}/_8$ ,  $^{14}/_8$ ,  $^5/_7$ ,  $^{19}/_7$ ,  $^6/_8$ ,  $^{27}/_8$ ,  $^{10}/_9$  54.

<sup>6)</sup> L. to BÄCK,  $^{12}/_2$  55, to WAHLBOM  $^{20}/_3$  55.

<sup>7)</sup> In winter he slept from nine to seven, in summer from ten to three. Egenh. Ant. p. 87.

king table in the palace as regularly as in his own quiet home at Upsala. But signs are not wanting that the Queen in her imperious turn of mind oftener than was agreeable felt called upon to favour him with her remarks, and to urge the speedy completion of a task the laboriousness of which she was far from comprehending<sup>1)</sup>, and that it is to such gracious surveillance LINNÆUS shrewdly alludes in the dedication to the Queen of the Museum Ludovicæ Ulricæ, when he declares that »whenever his descriptions had enjoyed the honour of being drawn up under Her Majesty's own most radiant eyes, he had felt that the difference between writing at court and in one's own Museum was fully as great as between a labourer's toiling in the hottest sunshine and his doing the same work in the coolest shade». The entry of a sum paid for the present of some plate<sup>2)</sup>, and »a beautiful golden ring with a ruby», the gift of the Queen in the beginning of 1753<sup>3)</sup>, perhaps imply some degree of atonement for many an annoying word. No doubt, also, some amends lay in »the charm of conversing every day with such a great and highminded Queen, a pleasure that well nigh had made LINNÆUS a cour-tier, a thing he had never dreamt of.»<sup>4)</sup>

Thanks to the close correspondence LINNÆUS held with his friend BÄCK, we have been enabled to follow him in his work and movements during this period almost from day to day. It appears that the two summer-visits to Drottningholm in 1751 and 1752, making in all about thirteen weeks, and the three visits to Ulriksdal in 1753 and 1754, of nine weeks, were the real working periods allotted to both collections. What follows will afford ample evidence that the Museum Ludovicæ Ulricæ has been written in all its essential parts in 1751 and 1752.

In the latin preface to the M. L. U. LINNÆUS says: »Con-jeci in Schedulas observatiunculas nonnullas meas, proprio

<sup>1)</sup> »Let me know if the Queen should press the work», — »It cannot be done as speedily as ordered», — »Let her not become impatient», — »I shudder whenever Drottningholm is mentioned, when there I feel as if in prison». — L. to BÄCK,  $\frac{1}{11}$ ,  $\frac{26}{11}$ ,  $\frac{28}{7}$  52;  $\frac{10}{7}$  53.

<sup>2)</sup> Nov. 19, 1751: »A Mr WITTKOPF pour argenterie donnée à Mr LINNÆUS, 913 D. Copper», or Crowns 383,46, = £ 21, s. 3.

<sup>3)</sup> Egenh. Ant. p. 52.

<sup>4)</sup> Egenh. Ant. p. 50.

imprimis „usui dicatas, ut vel aliqualis horum, mihi superesset idea.» Of these schedules, very nearly all containing the Insects, from the Coleoptera to the Aptera inclusively, were presented to the Swedish Academy of Sciences by BÄCK, who no doubt had them from the author himself and attested their authenticity, in an inscription on the cover. They have afforded excellent materials for an important Memoir by Professor CHRISTOPHER AURIVILLIUS, on the Lepidoptera of the Museum Ludovicæ Ulricæ <sup>1)</sup>. Altogether, there are 379 separate leaflets <sup>2)</sup>, small octavo, 165 mm. by 102 mm., nearly all through one, for each species, and then, almost without exception, written on one side only. Very rarely a leaflet contains two or even three species. They are all in the well-known small and not very legible hand, of LINNÆUS. <sup>3)</sup> The plan is given from the first. Every schedule bears, at the top, on the left a capital letter, A, B, etc. indicating the order of arrangement originally intended, and farther to the right a number, and often a small letter, to all appearance referring to the place of the specimen in the drawer. Under these marks comes the »differentia», the diagnosis, and under that a space is left open to receive the references to preceding authors and the figures given by them. Then comes the »descriptio», drawn up under the well-known heads, for the most part very regularly observed, as they are seen in the printed M. L. U. On every single schedule the original »differentia» and the »descriptio» are, almost without exception, in one and the same stile of handwriting, as if written with the same pen and ink, one immediately after the other. The references, on the contrary, inserted into the open space between both bear evident marks of having been added, in great part at least if not wholly, subsequently and at various times, and from the handwriting often being very similar all through a series of species, it will seem as if each author had been gone through once for all. Among the Coleoptera PETIVER is perhaps the earliest quotation, followed by MERIAN'S Surinam, OLEARIUS, RÖSEL, SLOANE, MARGRAF, while SEBA and GREW are among the latest. In some instances a

<sup>1)</sup> Recensio critica Lepidopterorum Musei Ludovicæ Ulricæ quæ descripsit CAROLUS A LINNÆ. K. Svenska Vetenskaps-Akademiens Handlingar, XIX, N:o 5. Stockholm 1882.

<sup>2)</sup> Coleoptera 72 leaves; Hémiptera 66, Lepidoptera 188, Neuroptera 1, Hymenoptera 18, Aptera 34.

<sup>3)</sup> See Plate I.

»nomen triviale» is written at the top of the leaflet, but always shows, by its position, its stile of writing and the colour of the ink, that it is not contemporaneous with the original diagnosis and the description, but has been added afterwards and separately. The trivial names thus given are, moreover, not always exactly those adopted in 1758 in the *Systema Naturæ* ed. 10; thus, for instance, in *Scarabæus*, *glaucus* stands for *Hercules*; in *Buprestis*, *gigas* for *gigantea*, *ignea* for *ignita*, *punctata* for *sternicornis*, *vulnerata* for *bimaculata*; in *Gryllus*, *longispinosus* for *fastigiatus*, *harlechinus* for *variegatus*. They are also often less in accordance with the rules observed there, as *Gryllus folium ambulans* for *siccifolius*, *folium viride* for *laurifolius*, *alis ocellatis* for *ocellatus*, *triocularis* for *triops*, *alana nigra* for *melanopterus*, and so on, — they are to all appearance preliminary and applied by way of trial. Many names, however, are such as were finally adopted.

The species collected by KALM in Canada and Pennsylvania, 1747—<sup>3</sup>/<sub>61</sub> 1751, and those sent from N. Carolina by GARDEN, have their separate schedules, and also generally capital letters and numbers. Those collected by OSBECK in his voyage to Spain, the East Indies and China, from 1750 to <sup>26</sup>/<sub>6</sub> 1752, have each found a place upon the back of some leaflet already the bearer of an allied species, and are without capital letters and numbers. They have evidently arrived just as the manuscript was finishing. Those species, on the contrary, that had been collected in the East by HASSELQVIST, and added to the Queen's cabinet in 1754, are missing throughout, and make their first appearance 1758, in the S. N. ed. 10, while those presented by TULBAGH in 1763 are, of course, found only in the M. L. U. of 1764 and the S. N. ed. 12 of 1767. One species alone, sent by GOUAN in 1758 or later, has a schedule for itself, in the hand-writing, exceptionally legible, of LINNÆUS himself. It bears at the top the number 402 which is that of its page in the printed book, as if thus marked for immediate copying and insertion into the proof-sheet.

The Genera are no other than those of the so-called sixth, properly the third, edition of the S. N., 1748. Thus the future *Hister* still goes under *Scarabæus*, *Silpha* under *Dermestes*, *Fulgora*, the *Laternaria* of the M. L. U., under *Cicada*, *Sphex* under *Ichneumon*, *Vespa* under *Apis*, *Sphinx* under *Phalæna*.

The descriptions are generally written *currente calamo*, and very rarely bear marks of having been corrected afterwards. In the Coleoptera and part of the Hemiptera there are here and there some few words exchanged or added, all along in the same hand, as if in the course of a general revision. Even when being copied for printing they never or very rarely were altered, and in the M. L. U. of 1764 agree very closely with the original MS descriptions, being only touched up and slightly rearranged where needed.

It is not so with the diagnoses, the »differentiæ», extracted from the descriptions<sup>1)</sup>. Originally they were very short, more so than when they appear 1758 in the S. N. ed. 10. But the words added are but rarely inserted on the manuscript schedule. In some cases the »differentiæ» are remodelled. When those of the S. N. of 1758 are compared to those of the M. L. U. of 1764, the greater number are identical, while some are amplified in the later publication. Some gross errata are no doubt to be attributed to the transcriber, as, for instance, in *Scarabæus* 8 *Rhinoceros*: »clypeo» for »labio», in *Buprestis* 10 *cuprea*: »orbiculari» for »tuberculari».

That the M. L. U. was not printed from the manuscript schedules, and that these never came in the compositor's hands, is made evident, first by the diagnoses of the printed work not seldom differing from those of the manuscript, secondly by the descriptions, although identical in both, being here and there somewhat touched up in the former, and thirdly by the abbreviated and almost illegible original writing of the references to the authors. There cannot be the least doubt that LINNÆUS had the schedules copied for publication, and revised them while this was doing. It is not only that in his correspondence with BÄCK<sup>2)</sup> in the year 1753 he repeatedly speaks of the copying of the »Museum Regina» or »Regis», but there actually exist among the original Linnean schedules a few very neatly transcribed ones, in a hand which certainly is not that of LINNÆUS. The species they contain are not found in the M. L. U. 1764, having been kept back for some reason, and their schedules were thus rescued from the ordinary fate of printed manuscripts.

<sup>1)</sup> »Mea nomina specifica e Descriptione extraxerunt Differentias». Phil. Bot. p. 258.

<sup>2)</sup> L. to BÄCK, 27/9 51, 28/1, 6/3, 26/6, 1/7 53

In the autumn term of 1755 LINNÆUS lectured on the Insects, and the notes taken by one of his hearers are still extant<sup>1)</sup>. »For the most part», he says, »I am going to put before you, as types, indigenous species only», and he alludes to the Queen's cabinet for only a few more remarkable exotic species. The preparations for »my new edition», the so-called tenth, properly the fourth, of the S. N., are manifest. Hister is dismembered from Coccinella, Silpha from Dermestes of the schedules, Sphinx from Phalæna, Bombylius from Culex. The »nomina trivialia» in use among collectors and describers, many of them carefully noted in the Lepidoptera of the Fauna Svecica of 1746, but there at the very base of the references, as for instance: 772, »vulgo Morio», 776, »vulgo Oculus pavonis», 778, »vulgo bella donna», are here promoted to their future position at the top, and thus raised to the dignity of representing species, but, strange to say, were mostly abandoned in the S. N. ed. 10, where some of them, however, are recorded from the Fauna Svecica. The principle of binary nomenclature is carried out, but its author has not yet made up his mind as to its manner of application in a number of special cases<sup>2)</sup>.

It cannot reasonably be doubted that the descriptions of the Testacea of the M. L. U. were originally written by LINNÆUS on schedules similar to those of the Insecta. Such is indeed the only method consistent with the necessity of having the series open at every point for the insertion of additional species, and in a state to be arranged and rearranged with facility. It has been seen that the MS of the Insecta was also copied on separate schedules, which were, no doubt, when finally arranged, put into the compositor's hands, and it is certainly no bold suggestion that such was the practice of LINNÆUS with all his descriptive works<sup>3)</sup>. The Linnean MS

<sup>1)</sup> Caroli Linnæi etc. Collegium privatum entomologicum, tempore autumnali 1755 habitum. MS in 4:o, 190 pag. In the Library of the Academy of Sciences.

<sup>2)</sup> »It is puzzling how to find »nomina trivialia» for all these butterflies, as we know nothing about the food of their larvæ, so I have given the names as they occurred to me. It matters not whether I know the reason or not why anyone of my hearers bears this or that name, if I can only distinguish you one from another by your names.» Lecture 1755.

<sup>3)</sup> Indeed, AFZELIUS says LINNÆUS habitually wrote down the descriptions on separate schedules, making 12 or 16' from a sheet of paper, and used to keep some such leaflets ready in his pocket-book.

of the Testacea and Vermes of the M. L. U., original or transcribed; is now however entirely lost, at least; as far as we know, no trace of it is extant, and recourse is to be had to other means for ascertaining the time and mode of the origin of this part of the work.

LINNÆUS lectured in the autumn of 1752<sup>1)</sup> on the Class of Vermes, and of the notes then taken among his hearers several copies are extant<sup>2)</sup>. Upon the whole these lectures formed a commentary on the sixth Class, Vermes; as this stands in the S. N., ed. 6, 1748. Its four Orders: Reptilia, Zoophyta, Testacea, Lithophyta, are maintained and the genera keep their numbers. Those of the first Order, numbered 210—215, as well as the first eleven, 216—226, of the second Order, are identical. In the fourth Order, the Lithophyta, which in the first and second editions were referred to the Regnum Vegetabile, disposed after BERN. JUSSIEU<sup>3)</sup>, the four genera 238—241 remain, but three new genera are added; not numbered: Isis for the Corallium rubrum, Lithoxylon for the Gorgonia flabellum etc. together with the Alcyonium arboreum, and Hippuris for the Isis

<sup>1)</sup> L. to BÄCK, 9/10 52.

<sup>2)</sup> Of the four copies here made use of two appear to give originals written down directly and separately, while the two others seem to be transcriptions at second hand. The four MSS are: a) A folio of 104 pages in the handwriting of PETER JONAS BERGIUS who was born 1730, a student at Upsala, responded 29/4 50, Præside C. LINNÆO, for the dissertation: Semina Muscorum, and was created M. D. in 1754. He died at Stockholm in 1790, having bequeathed his library with the rest of his property to the Academy of Sciences. The title: »Caroli Linnæi Patris» Lectures, added posteriorly, has no date, but under the genus Lithoxylon the words occur: »in this year 1752.» It comprises the whole of the sixth class and is evidently original and very correct. — b) A 4:o vol., Codex C, 160, in the library of the University at Upsala, seems to be a transcript of this. — c) A 4:o of 169 pages, in the library of the Academy of Sciences: »Lectures on the sixth class of the Animal Kingdom, Worms, Shells and Corals, delivered by the Archiater Dr C. LINNÆUS in the autumn term of 1752», a neat original, or a copy from one, different from the first. — d) A 4:o of 159 pages in the possession of Dr EVALD ÅHRLING, comes very near to the foregoing. — In the earliest outline of the future Systema Naturæ that has come to us, notes taken by MENNANDER from a Lecture of LINNÆUS delivered probably in 1733, preserved in the Royal Library, the sixth Class, answering to that of the Vermes, bears the name: Zoophyta, and its second Order comprises the »Ostracodermata», the future Testacea. It begins with 1. Limax, followed by 2. Cochlea: Planorbis, Helix, Paludina and a number of the »pretended» genera of the authors; 3. Nerita; Neritina fluviatilis; 4. Porcellana: Cypræa; 5. Auris marina: Haliotis; 6. Nautilus: Argonauta; 7. Coucha: Musculus 1. Mytilus; Chama, oblong, gaping; Pecten, Ostrea; 8. Cunnus marinus: Cytherea; 9. Patella; 10. Balanus; 11. Entalium. »Also Tethys, Holothuria and other genera mostly unknown».

<sup>3)</sup> L. to BÄCK, 13/4 44, highly praising the merits of JUSSIEU. See also the Corallia balthica.

Hippuris. Thus in these parts the S. N. ed. 6 had undergone no very great modification. With the third Order, the Testacea, it is different. This had been greatly remodelled; at the side of 229 Patella, 231 Cypræa, 232 Haliotis, 233 Dentalium, 234 Nautilus, the two enormous genera: 230 Cochlea and 235 Concha, have been dissolved into a series of numerous new genera, most of them afterwards finally adopted. Thus the whole of the Order is thoroughly altered; it is evident the studies at Drottningholm had done their work.

The choice collection of books on Natural History which then formed part of the Queen's library at her palace is now in that of the Academy of Sciences, and in it the copy used by LINNÆUS of his favourite author on Conchology, the »Amboinische Rariteiten-Kammer» of RUMPHIUS, Amsterdam 1705 <sup>1)</sup>. On thirty one of its plates, from XIX to XLIX, at 215 of their figures, I found names, written with a lead-pencil, faded now, but all legible, in the well-known hand of LINNÆUS as

<sup>1)</sup> In the MENNANDER MS of 1733 it is said: »Solo tactu, visu ætate ingravescente destitutus, colores conchyliorum dignoscere poterat, hinc oculatissimus cæcus passim audit». »Nullus indefesso magis studio atque diligentia Indiæ Gazophyllacia Naturæ perquisivit, cujus rei lucentissimum testimonium exstat Museum Amboinense quod in Conchyliorum historia reliquis omnibus, quæ de Testaceis prodire, longe palmam præripuit». Amæn. Acad. IV, p. 114. — GEORGE EVERHARD, RUMPHIUS, a German, born in 1627 on the domains of the Counts of Solms, was the son of a builder at Hanau. Having there completed his studies and obtained the degree of M. D., he spent three years in Portugal, and perhaps in Brazil, and in his 25th year enlisted as cadet in the service of the Dutch East India Company. Having landed, in the middle of 1653, at Batavia, he was soon afterwards sent to Amboina, and made ensign and surveyor of the public buildings. But military life not being to his taste he in 1657 entered the civil service in the quality of Under-Merchant to the Company, and, since he had become known as a man of great rectitude, thoroughly skilled in Arabic as well as versed in various sciences, and well acquainted with the mode of dealing with the Amboinese, he was in 1660 promoted to the office of Merchant. While honourably discharging the functions of that post, he declared, however, that these were only a mask he was compelled to wear in order to earn his livelihood, and that researches in Natural History, which he regarded to be of more importance, had formed the sole motive for his being there. During many years he had worked with unremitting ardour on his great Herbarium Amboinense, when, in 1670, cataract deprived him of his sight. The Company, unwilling to lose his highly valued services, in the following year appointed him President of one of its civil Courts, and in that office he remained for the rest of his life constantly devoting all his leisure hours to studies and researches. In the great earthquake which devastated the island on the 17 of February 1674, he lost his wife and youngest daughter, and in the beginning of 1687 a conflagration that destroyed the Dutch quarter of the town consumed a large part of his collections and library, and all the original figures belonging to the first half of the



this is seen in the contemporaneous schedules. They are nearly all only generic names and among the Cochleæ almost every one is followed by a number, as for instance »Murex 12», »Nerita 4», the same, no doubt, as that which at that time marked the species within its genus, in the pack of schedules. To a very few only a »nomen triviale» is added; mostly a quotation from RUMPHIUS, and in this case there is no number. It cannot be doubted that these pencil-notes were made by LINNÆUS himself when he first described the shells of the Museum Reginae.

An important manuscript, one of the relics preserved in the library of the Linnean Society, has been carefully discussed by HANLEY<sup>1)</sup>, the learned author of »Ipsa LINNÆI Conchyliæ» and many other excellent works. It is not written down by LINNÆUS himself; but in another, and very legible hand, with alterations and interpolations in LINNÆUS' own peculiar handwriting. It contains a series of his genera, such as they were conceived at an early period, and a large number of species with their »differentiæ» and references.

herbarium. But nothing daunted he with the aid of his son AUGUSTUS and a draughtsman sent him from Batavia, contrived to have them done a second time, and in 1692 the first six parts of the work could be sent to Holland with the homeward-bound fleet. This however was attacked by the French and the Admiralship on board of which was the package went to the bottom. Fortunately his friend the Governor General CAMP-HUIS had previously taken care to have the parts thus lost copied twice, and thus he could now, in 1696, forward them a second time to Holland and along with them three more parts which in the meantime had been sent in by RUMPHIUS, as also with the last vessels of that year the three concluding parts. At Amsterdam the work was laid before the Seventeen who deigned as a recompense to promote the author's son to the office of Merchant, and then permitted it to lie almost buried in oblivion till in 1736 BURMANN succeeded in bringing it to light, and having it published 1741—1755. — The MS of the »Amboinische Rariteiten-Kammer» was sent by its author in 1699 to his friend D'ACQUET at Delft, a great collector under whose auspices it was published in 1705 by SCHYNOERT, who added a number of figures, partly intended to represent species mentioned but not figured in the original, and accounted for these figures in the postscripts in italics appended to the various chapters. — Three other works of RUMPHIUS, on the History of Amboina, on its Geography, and on its mammalia, birds, reptiles and fishes, were published by VALENTYN in his description of the East Indies, as it seems without mentioning the real authors name. — The collections of RUMPHIUS never came to Europe. He died at Amboina on the 13:th of June 1702. — See: HENSCHEL, Vita G. E. RUMPHII, Dissertatio, Breslau, 1833. LEUPE: GEORGIUS EVERARDUS RUMPHIUS, ambonsch Natuurkundige der zeventiende eeuw, Verhandelingen der Koninglijke Akademie van Wetenschappen, Twaalfde Deel, Amsterdam 1871. BICKMORE, Travels in the East India Archipelago, p. 250, London 1868.

<sup>1)</sup> Journal of the Proceedings of the Linnean Society. Zoology, IV, p. 43.

These three records of the preparatory conchological studies of LINNÆUS: the Lectures of 1752, the pencil-notes to RUMPHIUS, and the HANLEY MS, deserve to be compared together and considered with regard to the origin and progress of the chapter on the Testacea in the Museum Ludovicæ Ulricæ.

It has been remarked above that when lecturing on the Insecta in 1755 LINNÆUS confined himself almost totally to species indigenous to Sweden, as these afforded him all he wanted to demonstrate the genera. The same method could not be followed with regard to the Testacea, their genera being for the most part founded upon exotic forms. It will be seen, however, that he took care, by allowing himself occasional deviations in the disposition and manner of treating of certain genera, to give his hearers some idea of the groups of Mollusks then known to him as Swedish, and that, consequently, the order of their sequence is not so entirely fortuitous as might be supposed from these words in the introduction: »that the genera are not placed in the same order as in the Systema Naturæ is not because of any change of system, but merely because they were taken as they were at hand». Such as they are, their constitution as well as their appellations give them a rather primitive and preliminary character. They follow here, in the order of the Lectures, with notices of the comments dictated by LINNÆUS on most of them.

## I. Cochleæ.

CYPRÆA. From the S. N. ed. pr., 1735. Thirty one species. The first is »*C. gibbosa*, for it is as it were humpbacked. It may be called: *C. subturbinata gibba, atropurpurea, maculis pallidis*. Not found in any author.» It seems to have been dropped afterwards. It is followed by thirty species very nearly in the same order as in the M. L. U. and the S. N. ed. 10, ending with *C. globulus*. Of the first 23 the eleven species numbered in the pencil-notes: 1, 2, 3, 4, 6, 7, 11, 12, 13, 14, 16, 23, are the species identically marked in the Lectures.

BULLA. »*Novum genus*». Eight species, the first six of the M. L. U., with *Murex ficus* and *M. rapa*. The numbers

1, 3, 5, 6, of the pencil-notes agree, but the *B. ficus* and *B. rapa*, 7 and 8; of the Lectures, are 9 and 10 in the pencil-notes.

**VOLUTA.** This name, from RUMPHIUS, is used for what soon became, or rather already, was *Conus*, which is adopted in the pencil-notes, with the exception of a single species, marked *Voluta* 4, the »Grauwe Munnikin» of RUMPHIUS, t. XXXIII, f. CC, the *C. monachus* of the M. L. U. and the S. N. ed. 10. Nineteen species. The numbers 3, 4, 5, 7, 8, 9, 14, 19, answer to 3, 5, 6, 10, 11, 12, 20, 25 of the pencil-notes, exactly as if the arrangement had been the same on both sides, and the species given in the Lecture had been picked out from the larger number in the Queen's collection. The order is entirely different from that in the S. N. ed. 10 and the M. L. U.

**CYLINDRUS.** Name from BONANNI, in the pencil-notes, and the HANLEY MS called throughout, by its future, and final name, *Voluta*. Eight species. The numbers 1—3 are the same in the pencil-notes, and the M. L. U.; the rest are selected.

**MUREX.** Twelve species, ten of which are in the M. L. U. *M. brandaris* and one not identified. The numbers 1—4 are the same as in the pencil-notes; the other four picked out from the list, which according to the notes has contained at least 26 species. In the notes, as in the HANLEY MS the *M. aruanus* and *trapezium* of S. N. ed. 10 are marked *Strombus* 11 and 7; while *M. babylonius*, *vertagus*, *aluco*, are marked *Turricula* 13, 6 and 9. Both these genera, as it will seem numerous in species, and not mentioned in the Lectures, were afterwards dropped<sup>1)</sup>, and the name *Strombus* substituted for *Harpago*. *Murex Tritonis* is marked *Cassida*.

**HARPAGO.** Name from D'ARGENVILLE, p. 288, adopted also in the pencil-notes and the HANLEY MS, exchanged in the S. N. ed. 10 for *Strombus*, from BONANNI. Thirteen species, all in the M. L. U. The numbers 1—4 represent the same species as in the notes; then follow five others marked with deviating, always lower numbers, clearly indicating their being selected from the larger list.

**CASSIDA.** Name from LANG, 1722, adopted in the notes and in the HANLEY MS. In the S. N. ed. 10 the genus is merged into *Buccinum* together with *Lyra* and part of *Morion*, which are not seen in the Lectures. Eleven species: now of

<sup>1)</sup> For *Turricula*, see S. N. ed. 10, p. 766.

*Dolium*, *Cassis*, *Nassa*, *Triton*. The number 1—4 are the same as in the notes; the three species then following have discrepant and lower numbers, from several having been omitted.

**TURBO.** Twelve species, all exotic and in the M. L. U. Nine of them are marked in the pencil-notes not with numbers but with trivial names, most of which were adopted in S. N. ed. 10, as: *marmoreus*, *petholatus*, *delphinus*, *calcar*. Others, as *os aureum* for *chrysostomus*, *tectum chinense* for *pagodus*, are found also in the Lectures.

**TROCHUS.** Five species, all exotic and in the M. L. U. Only two of them are in the notes, with numbers not congruent.

**NERITA.** Ten species: eight, exotic, in the M. L. U., with *N. littoralis* and *N. fluviatilis* of the S. N. Last comes »10 vitellum, the yolk, from its form and yellow colour: *Nerita edentula umbilicata labio supra umbilicum explanato*». Only one species is among the seven noted in RUMPHIUS.

**BUCCINUM.** In the pencil-notes as well as in the HANLEY MS the *B. perdix*, *B. olearium?*, *B. dolium*, *B. pomum*, are marked Buccinum. In the Lecture they are omitted and »1. *Harpa nobilis*», »2. *B. persicum*», marked in the notes: *Lyra 1* and *Lyra 3*, the only two exotic species mentioned. The third species is *B. undatum* followed by *Murex despectus*. »Among the species of the Fauna Svecica» (ed. 1) »the following are Buccina»: »1302» (*Bulla fontinalis* of Fn. Svec. ed. 2) »the only one that lives on land»; »1310—11, 1315—16 (*Helix stagnalis*, *H. fragilis*, *H. auricularia*, *H. balthica*, ib.) and 1317 (*Helix putris* ib.) are fresh-water species». »The following species« (of the Fn. Svec. ed. 1, besides these) »are marine: 1321, 1322, 1323, 1324» (*B. lapillus*, *Turbo terebra*, *Strombus pes pelicani*, *Nerita glaucina* Fn. Svec. ed. 2). It is seen that while the other genera of Testacea contain for the most part only exotic species, LINNÆUS here mentions very briefly those of Buccinum, and, conforming mostly to LISTER, takes the opportunity instead to point out summarily the indigenous species, for that end at the same time removing the genus from its proper position, and taking it up between *Nerita*, where two Swedish species are already introduced, and *Helix*. For the same purpose, in order to bring close together all the species then known to him of Swedish Gastropoda, he gives under

HELIX no exotic species<sup>1)</sup>, but as »terrestres»: Fn. Svec. 1293, 1294, 1295 and 1298 (*Helix pomatia*, *H. nemoralis*, *H. arbustorum*, *H. lapicida* of the Fn. Svec. ed. 2), and as »lacustres»: Fn. Svec. 1304, 1312 (*H. cornea*, *H. vivipara* ib.), while, in order not to break the sequence,

PATELLA begins with three indigenous species: Fn. Svec. 1291, 1292. (*P. vulgata*, *P. lacustris* Fn. Svec. ed. 2) and It. Vestrog. 171 (*Anomia Squamula* ib.). Having in this way given a comprehensive view of the Swedish Cochleæ, LINNÆUS goes on with the exotic Patellæ, *P. equestris* and seven more of the M. L. U., and one omitted there: »*Pileus solaris*, the sun-hat, *P. ovata striis subnodosis*. White with reddish stripes radiating from the centrum», the *P. solaris* of the HANLEY MS.

HALIOTIS. Name given in S. N. ed. pr. 1735; four species, all in the M. L. U.

DENTALIUM. Nearly as in the S. N. ed. 6. Ten species representing Dentalium, Serpula and Teredo of the 10th edition, among them the genera Vermetus, Siliquaria, Aspergillum.

NAUTILUS: »Testa univalvis, subspiralis, polythalamia seu multilocularis». Its Sepia is always on Octopod. . . occupying the last loculamentum». Eight species: (*Nautilus*, *Spirula*, *Orthoceras*, *Ammonites*, *Foraminifera*.)

CYMBIUM, the future Argonauta: »Testa univalvis, spiralis, unilocularis». Was hitherto ranged under Nautilus, but is monothalamous. Only a single species which is inhabited by an Octopod». »*Nautilus papyraceus Auctorum*».

LEPAS. Five species *Cirripedia*<sup>2)</sup>.

<sup>1)</sup> In the pencil notes to RUMPHIUS only two species are marked: »*Helix ampullacea*» and »*Morion* 7» which is the *H. scarabæus* as in the HANLEY MS.

<sup>2)</sup> Between Lepas and the Conchæ still lingers the fabulous genus 237, *Microcosmus*: »tegmen ex heterogeneis compilatis». Already in the Lecture of 1733, and later on in the S. N. ed. 2, 1740, ed. 6, 1748, and F. S. ed. 1, 1746, LINNÆUS gives the following references: THOMÆ BARTHOLINI *Hist. anat. rar. Centuria III et IV, Hafniæ 1657*, p. 284, on different sorts of whales, among them some of immense size; — an article by one PAULINUS in the *Ephemer. Acad. Nat. Curios. VIII, 1678*, p. 79, in which the Norwegian Sea-monster borrows the shape of a gigantic alg-disguised Hyas, with »trees of considerable height growing on its back»; — and REDI, *de animalculis vivis quæ in corporibus anim. viv. reperiuntur, Acta Eruditorum, 1686*, p. 48; transl. by COSTE, Amsterdam 1708, p. 88, where a good figure of an Ascidia is accompanied by a description drawn up in the most extravagant terms. LINNÆUS had never seen an Ascidia. Taking in full earnest the accounts from the North Sea and the highly poetic phrases of REDI, he said in the Lecture of 1752: »there would be every reason to assume the non-existence of the *Microcosmus*, did not so trustworthy men combine in asserting its reality

## II. Conchæ.

**PECTEN.** Name from **PLINIUS** and auct. Kept up in the notes and in the **HANLEY MS.**, afterwards included in the following. Twenty two species, for the most part in the **M. L. U.**

**OSTREUM.** Thus written in the notes and the **HANLEY MS.** Eleven species: now of *Placuna*, *Meleagrina*, *Avicula*, *Ostrea*, *Chama* (*lazarus*), *Malleus*.

**ARCA.** The only genus among the *Conchæ* of which the species are marked with numbers in the pencil-notes. Six species, *Arca* and *Pectunculus*, beginning as elsewhere with *A. tortuosa*.

**PHOLAS.** Name in common with the pencil-notes and the **HANLEY MS.** The characters of the genus are given thus: »*Testa lenticularis* (like a convex microscopic lens), *orbiculata*. The *rima* looks as if cut with a knife; at the anus it has an impression of a *figura cordata*. The shell is thick.»

»1. *Pholas sulco antice longitudinali*. **ARGENV.** t. 24, f. *N.* Is found at Jamaica. Pennsylvania, **KALM.**» This is the *Venus pennsylvanica*, 114, **S. N.** ed. 10; 67, **M. L. U.**; 138, **S. N.** ed. 12; *Lucina pennsylvanica* **LAMCK.** **HANLEY** remarks: »the character, in the **M. L. U.**, »*intus versus marginem violaceus*» was, I suspect, intended for *punctata* on the opposite page». It is probably a mistake of the copyist.

»2. *Pectinata*. **RUMPH.** t. 43<sup>1)</sup> f. *D.* *Pholas longitudinaliter striata*. Internally it is lined with a thick bark, which is whi-

as **BARTHOLIN** and **REDI.**» With regard to **REDI** he soon recognised his error, and in 1754, in the *Museum Adolphi Friderici*, p. 96, describes an *Ascidia* under the name of *Microcosmus gelatinosus*. In the tenth edition of **S. N.**, 1758, it has, however, disappeared. In the *Lectures* of 1765, speaking of *Helix* (*Planorbis*) *spirorbis*, he says: »the larva of the *Phryganea* makes use of this shell in building its house. The ancient authors speak of an animal called *Krake*, which stands in the **S. N.** ed. 6 as *Microcosmus*. People who believe they have seen it say that it resembles a floating island and that its test is composed of stones, shells etc. If it really exists, it may be something in the *Phryganea* way.»

<sup>1)</sup> In the editio princeps of the *Rariteiten-Kammer*, of 1705, every plate bears, at the top, to the left, the number of the page in front of which it is to be placed, and to the right the ordinal number of the plate itself. At the bottom nothing is seen except here and there the engraver's signature. Two of the plates had been wrongly numbered by the engraver. When that numbered **XLIII** is placed according to the direction, in front of page 138, to which it refers, it happens to precede the one bearing the number **XLII**, the place of which is indicated to be in front of page 140. Now, in the *Drottningsholm* copy this error had

tish, verging upon yellow; it is strewn with concave points.» LINNÆUS first marked the figure in RUMPHIUS: »Pholas», then crossed out this and wrote: »Lentula»: »Pectinata» is a quotation from RUMPHIUS, not an intended trivial name. The species is the Venus punctata, 116, S. N. ed. 10, where, »f. G.» is a misprint for f. D., repeated in the M. L. U. 69, and S. N. ed. 12, 140. The Lectures are right, against them all. The quotation originally dictated by LINNÆUS was quite correct, the emendation given by his son, of D. for G. was just, but 42 for 43 was a mistake; he too overlooked the false numbering of these plates. LAMARCK placed it in Cytherea, later authors in Lucina. In the Lecture held by LINNÆUS in 1772, »in his own Museo at Hammarby» it is marked: »deficit», and is not extant in the collection in the Linnean Society examined by HANLEY.

»3. Pholas decussatim striata. The authors have no correct figure of this species, nor is there any certain synonymon. Internally it is yellow.» The manuscript commented on by HANLEY appears to have nothing more than the two words »decussatim striata», expressing what LINNÆUS at the time may have regarded as the »character essentialis.» It seems hazardous from this alone to identify the species with the Venus exoleta, 117, S. N. ed. 10, which has none but transversal striae.

»4. Ramosa. Pholas sulcis nodosis. GUALT. t. 72, f. E, F; t. 75, f. A. ARGENV. t. 24, f. P. The sulci are as it were ramosi; going obliquely forwards, like branches.» The figure D on Pl. XLII

been rectified; the two plates are found placed as they ought to be, and their numerals neatly altered, XLIII to XLII and vice versa. It follows that LINNÆUS quoted them correctly and did not transpose them. Professor JEFFREY BELL, who on my request kindly looked to these plates in the copy in the library of the Linnean Society formerly possessed by LINNÆUS, writes me that on the plate marked on its upper-corner Fol. 138 the number XLIII is struck out and replaced by 42, and on the plate-opposite p. 140 the number XLII by 43. This correction however, even if it should be in the hand of LINNÆUS, is of some later date, since in 1752 he did not possess the book. In other copies of that same edition the misleading numerals have no doubt been left unaltered. SCHYNVOET, the editor of the Rariteiten-Kammer, in 1711 and 1739 undertook to publish anonymously the identical sixty plates, minus the letterpress, with an index only, giving latin names not in the original work. The title was: »Thesaurus imaginum cochlearum... quibus accedunt conchyliis mineralia... quorum maximam partem G. E. RUMPHIUS collegit; jam vero Naturæ Amator et Curiosus quidam in hunc ordinem digessit et nitidissime æri incidit curavit.» In order to suit this statement the references to the pages of the original work at the upper left hand corner were erased, together with the engraver's signature below, and, instead of the latter, each plate was marked at the right hand corner with an ordinal letter, from a to ooo, conformably to the number at the top, and thus the plate wrongly numbered XLII (properly XLIII) with *tt*, and that wrongly numbered XLIII (properly XLII) with *vv*. Two plates only, LIII and LIV, escaped being thus curtailed, no doubt because they were the property of the East India Company; see p. 262 of the original. The whole of the plates, being in this state, were acquired by one DE JONGE, who in 1741 published a second edition, a reprint of the entire Rariteiten-Kammer, in which the two plates XLII and XLIII are at last found in their proper places, and correctly numbered.

of RUMPHIUS, added in the S. N. ed. 10, is marked »Pholas», but this also is crossed out and replaced by »Lentulus». It is the *Venus pectinata*, 120, of the S. N. ed. 10; 72 of the M. L. U. and 144 of S. N. ed. 12, a *Cytherea* in LAMARCK, and a *Circe* in later works.

»5. *Ziczac*. *Pholas postice angulo recto circumscripta*. GUALT. t. 77, f. C. Is transversim striata, and the striæ are bent backwards. White with red stripes going zigzag; inwardly white»; »but the rima or opening is reddish» is added in one of the manuscripts. The figure in RUMPH. t. XLIII, f. C, is marked »Pholas». This is the *Venus scripta*, 121, S. N. ed. 10; 73, M. L. U., 145, S. N. ed. 12. *Cytherea scripta* LAMARCK, *Circe scripta* of later authors. It is not the *Venus ziczac*, 119, S. N. ed. 10; 71, M. L. U.; omitted in the S. N. ed. 12, and referred to *V. cancellata*, 118. See HANLEY l. c. p. 53.

Besides the three figures in RUMPHIUS: Pl. XLII f. D, *Circe pectinata*, Pl. XLIII, f. D, *Lucina punctata* and f. C, *Circe scripta*, a fourth on the same plate, f. B, also bears the pencil-note: »Pholas» but was later made the type of *Chama*, as *Ch. literata*. In addition to these the manuscript reviewed by HANLEY presents as species of »Pholas»: *Artemis prostrata* and *exoleta*, *Lucina edentula* and *incrustedata*, and the *V. ziczac* of the S. N. ed. 10. It seems that LINNÆUS at the time had in view the creation of one, or — if *Lentula* is more than an *alias*, — perhaps two genera comprising certain *Lucinæ* and *Circes*, and, among names at hand, applied to it that of *Pholas*, employed already by RONDELET, in 1554, and ALDROVANDI, in 1654, for *Lithodomus*. LISTER at first used it for *Saxicava*, An. Angl. 1678, but soon altered it, for that genus, into *Chamæ-Pholas*, while conferring the name *Pholas* on the genus finally so named in S. N. ed. 10. LINNÆUS who in 1752 knew this only from the account given by LISTER, and placed it in the genus *Solen* as *S. crispatus*, seems to have remained unacquainted with it from personal observation until A. R. MARTIN<sup>1)</sup> in 1760 brought him specimens from

<sup>1)</sup> ANTON ROLANDSON MARTIN, b. 1729, one of the disciples of LINNÆUS, who in 1757 »presided» over his dissertation de »Buxbaumia». MARTIN had rediscovered this moss, first found by CELSIUS twenty years before, but not observed since. »The Archiater», writes MARTIN in his autobiography, »was greatly pleased with this and praised me not a little before his disciples. It is laudable in him, that he never withholds the discoveries of others, but puts them in the same light with his own, which cannot but animate the young and promote science.» In the following year MARTIN, on the recommendation of LINNÆUS, and at the expenses of the Academy of Sciences, accompanied a whaling-ship from



Norway, as stated in the *Fn. Suec.* ed. 2, 2124. The name *Lentula* or *Lentulus*, in the pencil-notes twice substituted for *Pholas*, was suggested by the lenticular form of the shell. Both *Pholas* and *Lentulus* were abandoned and finally merged into *Venus*. Their transient presence in these preliminary studies of LINNÆUS is illustrative of the gradual development of his conception of the «Genus», the earlier groups, of narrow compass and arbitrarily limited, growing out into large natural assemblages.

*BUCCARDIUM*, the reading of the Lectures, the pencil-notes and the HANLEY MS; the future *Cardium*. Eleven species, all in the M. L. U. except the last: »11; RUMPH. t. 44, f. N. Is almost globular, pellucid, gapes; and there the margin is serrate». The quoted figure is noted: »Buccard», and the HANLEY MS. has it under that genus. It became the *Solen bullatus*, 31 S. N. ed. 10, marked as described from a specimen existing in the Queen's cabinet, but omitted in the M. L. U. of 1764; repeated 41, S. N. ed. 12. In the Lectures of 1772 it is said, under *Solen*: »8, anatinus is wanting; 9, bullatus, 10, minutus, wanting.» HANLEY gives the Linnean description taken from the Queen's specimen before it was lost. — Number 4 is *B. verum*, here as in the HANL. MS. the name for the *Cardium* called *muricatum* in S. N. ed. 10, p. 679, but in the emendanda corrected to *aculeatum*, which name was left unaltered in the M. L. U., being there of older date.

*TELLINA*. Eight exotic species, all marked *Tellina* in the notes, all in the M. L. U.

»1. The *Sunshine*, *virgata*, has strias transversales retrorsum imbricatas. ARGENV. t. 25, f. 4. Is either white with red or yellow radii or yellow or bluish with white rays. Often of a hand's length, ovate, that is »narrowed in the fore part.»

»2. ARGENV. t. 25, f. I. This is smaller, has strias transversas imbricatas; is oval, that is simply oblong; at the cardo it has a

Gotenburg to Spitzbergen, and from July 1759 to September 1760 travelled on the coasts of Norway. »On my return to Upsala I showed the Archiater my collection. He enjoyed it very much, and was pleased to introduce the new species of *Vermes* in the forthcoming edition of his *Fauna Suecica*. MARTIN was afterwards for many years a stipendiary of the Academy of Sciences and died in Finland 1786. See: SIMON NORDSTRÖM, Biographical Sketch of ANTON ROLANDSSON MARTIN, *Ymer*, I, 1881, p. 93, 95, and the diary of his Voyage to Spitzbergen, *ib.* p. 102; also Svenska Expeditionen till Spetsbergen år 1861 under ledning af O. TORELL, (The Swedish Expedition to Spitsbergen under the Command of O. TORELL), Stockholm 1865, p. 426.

prominent margo, the one going into the other, which is not the case in the preceding species.» In the lecture of 1772 it is noted: »4. *T. Gari*, wanting.»

»3. The little Ham, *petazunculus*, ARGENV. t. 25, f. O; GUALT. t. 88 f. T. *Tellina oblonga*, antice angulatum rostrata; the fore-part drawn out, like a snout.» The *T. rostrata*, 28, M. L. U., in which the reference to RUMPHIUS, t. 45, f. L. stands alone and the two here quoted were omitted, although made out already. The rest are: *T. foliacea*, *gargadia*, *scobinata*, *lingua felis*, *remies*.

SOLEN. Eight species: five of the seven in the M. L. U., followed by: »*Solen ovatus*, *obtusissimus*, *cardine depresso rotundato*, GUALT. t. 91, f. D, LIST. Angl. t. 5 f. 36», which became the *Mya truncata*; »LISTER, Angl. t. 5, f. 38», the future *Pholas crispata*; »*S. subarenaceo-marinus*, It. Vestrog. p. 187», *Mya arenaria*.

CUNNUS. Eight exotic species of the future Venus, out of the first twelve in the M. L. U., beginning with *C. Veneris*, the future *V. Dione*, followed by seven species without trivial names, representing *V. reticulata*; *V. dysera* ♀ of the M. L. U. and S. N. ed. 10, the *V. verrucosa* S. N. ed. 12, »ARGENV. t. 24, f. Q»; *V. fimbriata*; *V. dysera*, »ARGENV. t. 24 f. K», in the lecture of 1772 marked: »deficit»; *V. paphia?*, »ARGENV. t. 24 f. B». White with yellow rays; *pubes lamellosa*, that is with short, pointed membranæ, »the spinæ are here lamellæ»; *V. meretrix*; *V. maculata*: »*ovalis*, *vulvarians*, *nymphis nudis*, *conniventibus*» from the description in the M. L. U.

SPONDYLUS, the Chama of S. N. ed. 10, two species: *Ch. gigas*; *Ch. hippopus*.

CHAMA. The name is here used as by BELON, 1555, but is *Pholas* in the pencil-notes. Two species, both afterwards merged into Venus: 1. »*literata*, RUMPH. t. XLIII, f. B»; in the Lecture of 1772 it is said: »varies infinitely, the Queen has a whole drawer full of its varieties». 2, the *Venus deussata* of S. N. ed. 10; in 1772 marked: »wanting».

PINNA. Two species: »1, *obovata*, *cuneiformis*» seems to comprehend three or four species of the M. L. U. »2. Is probably the rarest of all bivalves, not in any author, and nowhere but in the Queen's cabinet. It is an extraordinary shell and its true shape very difficult to understand. There seem to be two valves united lengthwise on one side, not closing»

## Cochleæ.

Lectures 1752.	Notes in RUMPH.	HANL. MS.	S. N. ed. 10.
Cymbium		Cymbium	Argonauta.
Nautilus		Nautilus	Nautilus.
Voluta	Conus	Conus	Conus.
	vel Voluta		
Cypræa	Cypræa	Cypræa	Cypræa.
Bulla	Bulla	Bulla	Bulla.
	Morion	Morion	
Cylindrus	Voluta	Voluta	Voluta.
Buccinum	Buccinum	Buccinum	Buccinum.
	Lyra. Turricula.	Lyra. Turricula.	
	Morion.	Morion.	
Cassida	Cassida	Cassida	Strombus.
Harpago	Harpago	Harpago	
Murex	Murex	Murex	Murex.
	Turricula. Cassida.	Turricula. Cassida.	
Trochus	Trochus	Trochus.	Trochus.
Turbo	Turbo	Turbo	Turbo.
Helix	Helix	Helix	Helix.
	Morion.	Morion.	
Nerita	Nerita	Nerita	Nerita.
Haliotis	Haliotis	Haliotis	Haliotis.
Patella	Patella	Patella	Patella.
Anomia.			
Dentalium	Dentalium	Dentalium	Dentalium.
Serpula. Tereido.	Serpula.	Serpula.	Serpula.

(on the other side); »the colour is white and pellucid.» The *P. digitiformis* M. L. U.

MYTULUS. Four species, three of them indigenous: the future *M. edulis*, *M. anatinus*, *M. margaritiferus*; and »coriaceus», »RUMPH. t. XLVI, f. F», the future *M. lithophagus*, »from the East Indies».

The two tables here above are intended to represent the earliest generic nomenclature of the Testacea as it resulted from the studies in the Queen's cabinet in 1751 and 1752, and, for comparison's sake, its final aspect in the S. N. of 1758. The sequence of the genera is that adopted there.

The dismemberment of the two genera *Cochlea* and *Concha* was made at Drottningholm in 1751 and 1752. The new genera then created are all in the pencil-notes of the Rariteitën-Kammer. The greater part of them were already from the first conceived such as they were to be proposed in

Conchæ.

Lectures 1752.	Notes in RUMPH.	HANLEY MS.	S. N. ed. 10.
Solen.		Solen.	Pholas.
Solen.		Solen. Mytilus.	Mya.
Solen	Solen	Solen	Solen.
Mya. Pholas.	Mya. Pholas.	Mya. Pholas.	
Tellina	Tellina	Tellina	Tellina.
Buccardium	Buccardium	Buccardium	Cardium.
	Trunculus	Trunculus	Donax.
Cunus	Cunus	Cunus	} Venus.
Pholas	Pholas	Pholas	
Chama	Pholas	Chama	
	vel Lentula		
Spondylus	Spondylus	Spondylus	Spondylus.
Arca	Arca	Spondylus	Chama.
Ostreum	Ostreum	Arca	Arca.
Anomia. Myt. Chama.	Mytilus. Spondylus.	Ostreum	} Ostrea.
Pecten	Pecten	Mytilus. Anomia.	
Ostreum		Pecten	
Mytilus	Mytilus	Ostreum	Anomia.
Ostreum	Ostreum	Mytilus	Mytilus.
Pinna	Pinna	Ostreum	
		Pinna	Pinna.

1758, and such as they still exist as families. A few were abortive, such as Cunus, Pholas, Chama, which were remodelled afterwards and merged into Venus, while Morion and Turricula, not mentioned in the Lectures, were dropped. Chiton, Donax and Spondylus were unrepresented in the Queen's cabinet. The generic names chosen, mostly from older authors, were little more than provisional, some to be altered afterwards, as certainly was one among them, suggested by the Venus Dione and hardly fit for a work dedicated to the Queen. Old appellations, as Voluta, as used by RUMPHIUS, and Cylindrus, seem to have been thought to do well enough for the occasion, while Conus L. and Voluta L. were already in store, to appear in the final work.

It has been seen that the numbering of the species in the Lectures, all through the first seven genera from Cypræa to Cassida inclusively, generally agrees with that of the same species in the copy of RUMPHIUS, in such a way however, that

the species first in order in each genus bear identical numbers in both, after which the numbers differ in such a manner as makes it appear that LINNÆUS, after having pointed out those first species as the most typical, selected among the rest such as seemed worth mentioning or of which specimens were at hand and could be shown to the hearers<sup>1)</sup>. From this partial accordance and constant mode of disagreement it seems only fair to conclude that LINNÆUS had at his disposal a list of species much more numerous than that given in the Lectures, and that this list had been compiled from the schedules of the descriptive catalogue of the Queen's cabinet he had drawn up a few months before. It is very probable that the HANLEY MS is a copy of this list. It would be of great interest to have it published as it is, unaltered.

Of the species given LINNÆUS dictated short diagnoses, for a smaller number in Swedish, while for the greater number he gave the »character essentialis» partly in a few Latin words and partly in Swedish. In most instances the Latin phrase is the same as in the HANLEY MS, though sometimes shorter, and gives the impression of having been extracted from the »differentia» or of being derived from that and the »descriptio» in the M. L. U., such as these were worded primitively, having, for instance, »pone» for »postice», »os» for »apertura» and »faux». The following are some examples:

»6. Gigas, for it is the biggest of all the Volutæ. *Voluta submarginata*, basi rugosa, spira planiuscula mucronata. GUALT. t. 21, f. B; is white with dark bluish spots.»

»8. Panthera, is like a Panther. *Voluta fusca*, maculis albis ovatis. GUALT. t. 22, f. D. Resembles outwardly a black-pudding with plenty of lumps of fat shining through the skin.»

»15. Drap d'or. *Connus aureus*, *Connus aulicus*, for it is white and, as it were, »chamarre» by its waved yellow lines. *Voluta picta venis reticulatis maculisque luteis adspersa.*»

»2. Telescopium. *Trochus exumbilicatus labio postico recurvato*. ARGENV. t. 14, f. B., GUALT. t. 60 f. D., long, like a nine-pin, striated, mostly of an auburn colour.»

»4. *Pileus equestris*, the troopers cap. *Patella ungue fornicali*. ARGENV. t. 6, f. K. GUALT. t. 9, f. X. Easily known by the un-

<sup>1)</sup> A few rough sketches in the margins of the notes were perhaps taken from specimens thus circulated, belonging to the »Museum Academia Upsaliensis»; see S. N. 1758: Ratio Editionis, and the dissertation: *Instructio Musei*, 14/11 53, Am. Acad. III, p. 446. The letters M. U. in LINNÆUS' own collection no doubt mean Museum Upsaliense, not Museum Ulricæ, an appellation never seen in his writings or his letters.

gulate processus it has inwardly in the centrum; is pellucid, conical, slightly contracted at the vertex.»

»6. Cor Veneris. Cartissa Rumphii. Buccardium compressum, valvis carinatis, carina dentata, umbonibus contiguus. GUALT. t, 84, f. B. C. good; ARGENV. t. 26, f. I.»

At other times, speaking of some more remarkable species, LINNÆUS treats his hearers with a latin »descr.» in full. Such is that of the Arca Noæ, which nearly agrees with the one in the M. L. U., as this may have been written down at first, with »umbones» for »nates»:

»6. Arca Noæ. Arca oblonga antice hians, compressed beneath, somewhat like a boat. Is seen in GUALT. t. 87, f. H. I., ARGENV. t. 26, f. G. Rather rare. Descr. Testa striis elevatis longitudinalibus distincta »(sic! distinctis?)», rugosa, antice subcompressa et fere biloba; umbones remotissimi, interjecto spatio angulo recto striato. Margo antice hians, apertura barbata, barba nigra. Color ex albo rufoque nebulosus.»

In like manner the »descr.» of *Ostreum malleus* is exactly that of the M. L. U., 121, only this has been slightly revised before printing:

»11. Malleus, the hammer, often costs 40 to 50 ducats. GUALT. t. 96, f. D, good, ARGENV. t. 22, f. A. *Ostreum testa cruciformi*. Descript. Testa rudis, inamoena, rugosa, flexuosa, opaca, linearis, ad basin utrinque exserens ramos solitarios, augustiores, oppositos, parallelos, rectos, paullo breviores; cavitas minima (curious that so big a shell has so small a logement for the animal) ad basin recedens, ovata, subargentea, colore conchæ margaritiferae. Rami (intus quam extus) glabriores, non vero argentati; cardo vix manifeste prominens angulo acuto utrinque sulco exsculptus.»

Of the *Venus Dione* a description is given not in the least comparable to the »descriptio absoluta» of the S. N. ed. 10, but almost word for word agreeing with that of the M. L. U., 55, the few less strict and more circuitous expressions suggesting a rather primitive and somewhat unsettled terminology:

»1. Cunnus Veneris. RUMPH. t. 46, f. 4. GUALT. t. 76, f. D, not good. ARGENV. t. 24 f. I, good. OLEAR. t. 29 f. 4. LIST. Hist. t. 307, f. 146. PETIVER Gaz. t. 31, f. 9. Cunnus antice spinoso pubescens. It were no wonder, had the poets seen this species, they have said Venus was born from the froth of the sea or from a sea-shell. At the close of the last century it was kept at a very high price, often more than 30 ducats, now it is to be bought at one ducat, with all the spines entire. Testa dimidiato cordata rugis transversis, distinctis, lamellis integris erecto-recurvis, æqualibus, antice

modice convexa, oblique striata, area longitudinaliter distincta a lateribus spinis ciliatis compressis, subtus canaliculatis, antrorsum incurvatis; rima lanceolata dehiscens; nymphæ lineares acuminatæ; umbones recurvati; ani area ovata, lævigata; dentes cardinis duo, anteriore obtuso majore, altero compresso; tertius dens in altera testa solitarius divaricatus. Color albo-incarnatus, intus albus; margo integer.»

These descriptions are no doubt as many fragments preserved to us of the primitive »Testacea» in the M. L. U., such as they had been originally written down at Drottningholm on schedules that have been lost.

At an earlier period than is generally supposed LINNÆUS had formed a clear and definite conception of the application to be made of the binary nomenclature in the great work.<sup>1)</sup> he was preparing. ÅHRLING<sup>2)</sup> has very properly drawn attention to the remarkable fact, first observed by him, that in the index to the travels in the isles of Gotland and Oeland<sup>3)</sup>, LINNÆUS has inserted a systematic enumeration of the plants observed,<sup>4)</sup> in which, throughout, every species is designated by its generic name, its number in the Flora Svecica, then just published<sup>4)</sup>, and a »nomen triviale», almost invariably consisting of a single word, printed in italics, and nearly always sought for in vain, in that connexion, at the quoted place in the diary itself<sup>5)</sup>. It will appear that he took this opportunity of seeing the binominal method in print and thus to give a trial to the great innovation to be introduced into the System, of which it was, in fact, a *conditio sine qua non*. In the month of december 1749 he »presided» over the well-known dissertation Pan Svecus<sup>6)</sup>, on the species of plants eaten or

1) The Species Plantarum. L. to BÄCK <sup>27/9, 12/11</sup> 51; <sup>1/3</sup> 52; <sup>13/4</sup> 53.

2) Studier i den Linneanska Nomenclaturen och Synonymiken (Studies on Linnean Nomenclature and Synonymistie), Örebro. 1872. 8:o.

3) The dedication is dated 4 of October 1745.

4) The preface is dated 10 of August 1745.

5) The following instances are taken at random:

	Index.	Diary.
Veronica	7 <i>spicata</i>	p. 72, 128, 216, 228, V. <i>spicata</i> minor. p. 215, V. <i>floribus spicatis</i> etc.
Scirpus	39 <i>maritimus</i>	p. 112, 216, Sc. <i>culmo triquetro</i> etc.
Arundo	102 <i>arenaria</i>	p. 139, Ar. <i>foliorum lateribus convolutis</i> etc.
Saponaria	346 <i>carolina</i>	p. 282, S. <i>calycibus pentaphyllis</i> .
Dianthus	345 <i>semibarbatus</i>	p. 301, D. <i>floribus aggregatis</i> etc.
Pulsatilla	447 <i>retroflexa</i>	p. 47, P. <i>flore minore nigricante</i> . p. 98, P. <i>foliis decompositis pinnatis, flore</i> etc. p. 152, P. <i>flore pendulo</i> etc.

6) Amœn. Acad. II, p. 225.

rejected by the different kinds of cattle, from observations made by himself and some of his disciples, and the noting down of which no doubt had been facilitated by letting a single word, »epitheton quoddam», take the place of the »nomen specificum». To this dissertation he refers in the eighth chapter of the *Philosophia Botanica*, where he lays down the rules in virtue of which the »nomen specificum», containing the »notas essentialia differentia», has been developed into that most efficient vehicle of systematic order, the diagnosis, now fallen into disuse. »The trivial names», he says, »for which there exist no rules, may perhaps be admitted in the manner in which I have used them in the *Pan Svecus*. They should consist in a single word, taken freely, from anywhere. I have come to this from seeing that the differentia frequently becomes inconveniently long, and is subject to alterations necessitated by the continual discoveries of new species.» He shows, by way of example, how the five species of *Pyrola* in the *Flora Svecica* might be distinguished by trivial names, and leaves the subject with the remark that »the names given by his predecessors were properly *nomina trivialia*, and those given by the oldest Botanists *maxime trivialia*». It is evidently with great caution and circumspection that he proceeds to accomplish the great reform, lest »even true botanists should feel induced ever to propose a *nomen triviale* alone without a sufficient *differentia specifica*, and thus the science be caused to relapse into the *pristina barbaries*». With this warning he takes the great step, and in the species *Plantarum*, 1753, and the *Museum Adolphi Frederici* 1754, raises the »*nomen triviale*» from the bottom of the references to preceding authors where he left it in the *Fauna Svecica* of 1746, to a higher position, on a level with the »*nomen specificum*», but still »in margine»<sup>1)</sup>, and there he lets it remain in the *Systema Naturæ* ed. 10, 1758, ed. 12, 1767, and the *M. L. U.* 1764, only no longer printed in small italics. In the meantime however, in the *Flora Svecica* ed. 2, 1755, he had allowed the »*nomen triviale*» to leave the margin and take possession of its due place next to the generic name, between this and the »*nomen specificum*», but still within parentheses, and it was only in 1761, in the second edition of the *Fauna Svecica*, that freed from such restriction it attained the position designed for it from the beginning.

<sup>1)</sup> *Species Plantarum*. Holmiæ 1753, I, *Lectori æquo*.



Although at the time perfectly clear about the binary nomenclature, LINNÆUS applied it but partially to the species in the Museum Regiæ which he described in 1751 and 1752: He seems to have kept back the task of definitive denomination until he should have before him a larger series of species to name, for instance an entire genus. It has already been remarked that in the manuscript of the entomological part of the M. L. U. a binary denomination occurs but sparingly as well as unequally. It is the same also in the Lectures on the Testacea of 1752; in one or another genus species are named nearly throughout, in others scarcely at all, and the rule of the »nomen triviale» a »vocabulum unicum» is not always maintained. Almost the whole of the Cyprææ are provided with binary denominations, nearly all identical with the final ones; only *C. cribraria* is called *argiolus* as in the HANLEY MS, and *C. stolidula* is named *spectrum*; four species have names of two words, as *Mappa geographica*, *massa vitulina*, *ovum Vanelli*, *lapis Hirundinis* <sup>1)</sup>, and two are unnamed; *C. lota* and *C. erronea* <sup>2)</sup>. The Bullæ are all definitively named, except *B. nauticum* which is called *B. bullula*. Nearly every species of *Harpago* and *Cassida* has received its future name, a few names only having been altered afterwards. In *Murex* some of the names are the permanent ones, some provisional, »*noms de guerre*» <sup>3)</sup>; as *unguis odoratus* for GUALT. t. 38, f. A, ARGENV. t. 19, f. C. It is the same in *Trochus*, *Turbo*, *Nerita*, *Patella*. In *Voluta*, that is: *Conus*, the greater number are »*noms de guerre*» as »*Drap d'or*», »*Dentella flava*», and it is nearly the same in *Cylindrus*, the future *Voluta*. Among the *Conchææ*

<sup>1)</sup> A current trivial name, from the old belief that the swallow has a stone in its stomach. L. in Lectures 1772.

<sup>2)</sup> When we learn from HANLEY that this species in his MS was named *erratica*, we may conclude that the absurd »*Errones*», the plural of *erro*, is the perpetuated mistake of some careless transcriber. In the Lecture of 1772 it is said of this species: »from its looking mean and rude it has received the name of a vagrant or gipsy.»

<sup>3)</sup> »*Les sçavans*» says D'ARGENVILLE, ed. 1742, p. 121; »apellent les noms françois qu'on a donnés des noms de guerre.» His work is full of them, and so are, in other languages, those of RUMPHIUS, VALENTYN and others, as carefully recorded by SCHRÖTER in his »*Einleitung*.» Generally suggested by some random association of ideas not seldom absurd enough, many of these names were picked up by LINNÆUS at an early time and set aside for future use. In the Lecture, on the Testacea of 1772 he says: »*nomina trivialia* are to be selected as nearly as possible in accordance with the ideas of the old authors, and the names they have given preserved as far as possible.»

Pecten and Cunnus present not a trace of a binary nomenclature, and, with one exception, not a single trivial name, the nomen specificum following directly upon the generic name. In the other genera true binominals occur only here and there, while frequent use is made of a current nomen triviale alone, mostly from RUMPHIUS; sometimes it is remarked: »has no nomen triviale», while, on the other hand, the diagnosis, the »nomen specificum», is preceded by a: »may be called», according to old custom. Thus it is seen that LINNÆUS, while strictly working out in 1753 for the Species Plantarum the binary nomenclature he had long kept in readiness, and while calling it into play chiefly for the Vertebrates in the Museum Adolphi Friderici of 1754, at the same time used it but partially and by way of trial only, when describing the Queen's cabinet and when lecturing on the Testacea and the Insects in 1752 and 1755, until he finally applied it when working out the Animal Kingdom, in 1756 and 1757, for the so-called tenth edition of Systema Naturæ 1758, which he introduces thus: »finem operis obtinuero, si inde . . . nomina magis stabiliantur, imprimis *Trivialia* et *Generica*.»

The frequent references to figures in the works of preceding authors form a very striking feature of the Lectures of 1752, and give additional support to the view that the chapter on Testacea was in the main an abstract of the M. L. U. as it existed already as a MS. It seems even probable that LINNÆUS actually had before him the very schedules he had written down some weeks before in the Queen's cabinet, and read out of them what he found convenient to mention, at the same time pointing out in the authors he had at hand the figures of those species of which he had no specimens to show in his own collection or in the Museum Upsaliense. In the Prolegomena he reviews the conchological authors up to the time. He mentions ALDROVANDUS and JOHNSTON, COLUMNA with his commentator MAJOR, and HARDERUS, and briefly comments on the works of LISTER, PETIVER, RUMPHIUS, BARRELIER, LANG, HEBENSTREIT, D'ARGENVILLE, GUALTIERI. »The principal authors for a serious study of this order are BONANNUS, LISTER, RUMPHIUS, D'ARGENVILLE and GUALTIERI. Whoever possesses these may dispense with the rest.» The following were accessible to LINNÆUS; those numbered are quoted in the Lectures.

1. D'ARGENVILLE, *l'Histoire naturelle éclaircie . . . . la Conchilologie*, Paris 1742; the edition always quoted by LINNÆUS who never knew the second of 1757. »A necessary book». In the Queen's library and in that of LINNÆUS himself.

2. GUALTIERI, *Index testarum conchyliorum*, Florence 1742, »likewise a necessary book; has more figures than D'ARGENVILLE, but some are mere varieties.» In the Queen's library, and in his own.

3. RUMPHIUS, *d'Amboinsche Rariteit-Kammer*, Amsterdam 1705. The copy mentioned above in the Queen's library at Drottningholm. »An indispensable book. The figures look rude, but are accurate.» LINNÆUS did not possess it at the time, since in 1753 he asks for the loan of it to Upsala<sup>1)</sup>.

4. PETIVER, *Gazophylacium naturæ et artis*, in 8:o, 1702—1705, and in fol. 1709—1712. Decas I—X, t. 1—100; add. *Aquatil. anim. Amboinæ*, t. 1—20, nearly 400 figures, mostly copied from RUMPHIUS. In the Queen's library, not in LINNÆUS' own possession. In the lectures 1752 and 1765 he says: »Perfect copies are not easily to be had. On the death of PETIVER, about 1708, a hundred plates were engraved but only fifteen printed off. SLOANE bought the whole stock and had it completed, but on being blamed for asking a somewhat high price for it, determined not to sell a single copy more, and thus it became a very rare book. I procured a copy for the Queen, at rather a high price»<sup>2)</sup>.

5. BONANNI, *Museum Kircherianum*, fol. 1709; Cl. I, f. 1—39; Cl. II, f. 1—135; Cl. III, f. 1—412; in all 586 figures mostly copied from the following and redressed. In the Queen's library, from that of Count TESSIN, possibly a later acquisition.

*Id.*, *Ricreatione dell'occhio e della mente*, 4:o, 1681: Cl. I, f. 1—20; Cl. II, f. 1—100; Cl. III, f. 1—319, in all 439 figures for the most part reverse. In the Queen's library.

*Id.*, *Recreatio mentis et oculi*, 4:o, 1684: Cl. I, f. 1—20; Cl. II, f. 1—100; Cl. III, f. 1—406, in all 526 figures. The edition chiefly quoted by LINNÆUS, probably from a copy still extant with the nominal phrases of the letterpress added, it is said, in the handwriting of King ADOLPHUS FREDERIC.

<sup>1)</sup> L. to BÄCK,  $\frac{1}{6}$  53.

<sup>2)</sup> Entry into the accounts of the Queen, dec. 16, 1751: »Une lettre de change pour bois de cèdre et le livre de Petiver, venus d'Angleterre.» 294 Doll. copper = Crowns 117,60, £ 6. s. 4.

Id. Supplementum Recreationis mentis et oculi, in: Observationes circa Viventia, 4:o, Romæ 1691, p. 316, f. 1—47. In the library of Count TESSIN.

6. LISTER, Historia Animalium Angliæ, tres tractatus, 4:o, 1678. In LINNÆUS' own library.

Id. Appendicis editio altera, in: GOEDARTIUS de Insectis, 8:o, 1685. In LINNÆUS' own library.

7. Id. Exercitatio anatomica, I, II, III, 1694—1696. In LINNÆUS' own library.

8. Id. Historia Conchyliorum, folio, 1685—1692. Two copies were in the Queen's library, one containing the land- and freshwater-shells alone, altogether without numbers, and 22 plates of anatomical details from the Exercitationes, the other comprising all the four books, with the appendix and the mantissæ. The plates are numbered only from 1 to 218, which is the vignette introducing Lib. III, P. II. »A capital work, only it is a pity the plates are not numbered, so that they cannot be quoted properly.» »LISTER was a great genius, industrious and careful.» In the lecture of 1733 LINNÆUS says it to be in the University Library at Upsala. The copy still preserved there is one of the very earliest impressions, being entirely without any numbers whatever or any inscriptions, beyond the usual abridged ones indicating the habitat. LINNÆUS sometimes refers to the figures in a very circuitous way, but in many instances, already in the lectures of 1752, by numbers, and these too very high, I do not know from what source. There existed numbered copies already in 1702, as quoted by PETIVER in the description of t. V of the Gazophylacium. HUDDSFORD's edition is of 1770; it was presented in 1772 to LINNÆUS by the University of Oxford<sup>1)</sup>.

9. PLANCUS, de Conchis minus notis, fol. 1739. In LINNÆUS' own library.

10. OLEARIUS, die Gottorfische Kunstkammer, 4:o transv., 1666. In the Queen's library and in that of LINNÆUS.

With the exception of 6, 7, 9, the works marked 1—10 were all at hand in the library at Drottningholm and one at least, PETIVERS Gazophylacium, not be found anywhere else in the country. With two exceptions of little moment they are likewise cited in the M. L. U. If this work and the lectures are compared together, it will be seen that there are in the Testacea:

<sup>1)</sup> Egenhänd. Anteckn., p. 65.

in the Mus. Lud. Ulr., containing species 434 against 273 in the lectures:					
	quotations from GUALTIERI	228	»	108	»
»	» D'ARGENVILLE	187	»	108	»
»	» RUMPHIUS	223	»	22	»
»	» PETIVER	5	»	7	»
»	» BONANNI	11	»	2	»
»	» LISTER Angl.	8	»	6	»
»	» — App.	1	»	0	»
»	» LISTER Excort.	0	»	1	»
»	» — Hist.	1	»	1	»
»	» PLANCUS	1	»	4	»
»	» OLEARIUS	0	»	1	»

The three first were the standard works of reference. It seems singular that quotations from RUMPHIUS, the favourite author, so frequent in the M. L. U., are so rare in the Lectures, but this seems to be fully explained by the circumstance that LINNÆUS could not show to his hearers the figures of this author, which he did not possess at that time, as he could those of GUALTIERI and D'ARGENVILLE.

Many quotations are common to the Lectures and the M. L. U., and in a few cases, where the quotation given in the latter work has been corrupted by the transcriber, the original correct notation is found in the Lectures. Thus, for instance, the quotation under the *Tellina gari*, from D'ARGENVILLE t. 25, is *I*, not *F* as in the M. L. U.; that under the *Cypræa tigris* from RUMPHIUS, t. 38, not t. 36 as in the M. L. U. Under the *Harpago Auris Dianæ* the quotation from D'ARGENVILLE is t. 17 f. *O*, not the erroneous one in the M. L. U., a blundering reiteration from GUALTIERI. Under the *Serpula anguina*, the *Solen anguinus* of RUMPHIUS, the Lectures, like the S. M. ed. 10, have D'ARGENVILLE t. 29 f. *H*., not GUALTIERI t. 29 f. *H* as in the M. L. U. It has already been remarked that the Lectures, under the *Pholas pectinata* of RUMPHIUS (the *Venus punctata* L.) are right in citing f. *D*, not f. *G*, against the S. N. ed. 10, the M. L. U., and the S. N. ed. 12.

In some instances the authors primitively referred to are but partially quoted in the different works. The future *Tellina rostrata* is in the Lecture called: *Petazunculus*, pointing to RUMPHIUS, but without quoting him, while D'ARGENVILLE and GUALTIERI are cited, as also in the S. N. ed. 10, but omitted in the M. L. U., where the citation from RUMPHIUS stands alone. There can be little doubt that all three were

in the original schedule, but afterwards were distributed in this manner by the copyist. In like wise the M. L. U. of 1764 under the Venus Dione has only the usual three authors: RUMPHIUS, GUALTIERI and D'ARGENVILLE, while already the Lectures of 1752 have in addition: OLEARIUS, LISTER, Historia, and PETIVER, that is exactly the full references given in the S. N. ed. 10, 1758, which, therefore, must have been made out and written down at Drottningholm for the M. L. U., but in that work given only partially whilst it was being prepared for printing. The work of PETIVER, of which the only copy accessible to LINNÆUS was at Drottningholm as early as in December 1751, is cited for twelve species only in the M. L. U. and the Lectures taken together, but of these twelve quotations one alone refers in both to the same species, the *Cypræa hirundo*. Of the remaining ten, four are in the M. L. U., 1764, and six in the Lectures, 1752. It cannot well be doubted that these six, all belonging to species in the Queen's Cabinet, were originally inscribed on their respective schedules in the primitive MS, as also, along with them, the very great number of quotations found in the S. N. 10, but were simply omitted when the work was being written out for the press. It would be easy to multiply the instances of the original references having been thus distributed between the different publications.

From the particulars thus dwelt upon at some length, from the statements of the autobiography and the correspondence with BÄCK, and from the following facts: first, that the original schedules of the entomological part of the M. L. U. represent the state of the Insect Cabinet up to the end of 1752, and not beyond that time; secondly, that the great generical transformations of the Testacea in comparison to the S. N. of 1748, that appear in the Lectures of the autumn of 1752 in close accordance with pencil-notes in the authors own hand no doubt made shortly before, evidently are derived from the original MS. of the M. L. U., from which the Lectures have received not alone diagnoses, but in some instances even entire descriptions verbatim transferred; and thirdly, that certain references to preceding authors, distributed between the different works, must have had their common place of origin in the primitive MS. of the M. L. U., it

becomes clear, that this work was in all its essential parts written down in 1752, and made ready for printing in 1753. It is to this work, then waiting for publication; that LINNÆUS refers, as »M. L. U.», in numerous places in the S. N. ed. 10, in the »Ratio Editionis» of which he enumerates it among »Collectanea»: »Lovisæ Ulricæ Reginae Museum Msc. in Conchiliis et Insectis stupendum, descriptionibus adornavi; and further on, p. 552, says: »Descriptiones insectorum omisimus, cum indigenorum sistat Fauna Suecica; exoticorum tradat (M. L. U.) Museum Ludovicæ Ulricæ Reginae». In the dissertation on the collections from China presented by LAGERSTRÖM to the University Museum at Upsala<sup>1)</sup> LINNÆUS says that he will omit: »ea omnia quæ ad prelum parata et destinata pro tomo secundo Musei Regis ut et Museo Ser. Reginae, ne fallacem in alienam messem injiciam», thus giving us to understand that the more elaborate descriptions were kept in store exclusively for those Royal volumes.

The two works, the Museum Regis and Reginae, were to be illustrated with figures, and LINNÆUS expressed his apprehensions regarding the possibility of finding a draftsman and an engraver as expert as required.<sup>2)</sup> This difficulty, however, was overcome, and he was soon happy to hear that LORENZ PASCH<sup>3)</sup>, a painter of no small renown, had been gained for the Mammals, and to have to send his thanks for figures of snakes to no less a person than OLOF DALIN<sup>4)</sup>, the future eminent historian of Sweden, at that time teacher to the Crown-prince. The drawing-master of the Princes, J. E. REHN, seems to have contributed some figures of fishes.

While this was doing for the Museum Regis, other artists were at work for the Museum Reginae. The well-known En-

<sup>1)</sup> *Amœnitates Academicæ*, IV, p. 233, <sup>23</sup>/<sub>12</sub> 54.

<sup>2)</sup> L. to BÄCK, <sup>8</sup>/<sub>9</sub> 52.

<sup>3)</sup> Probably the elder PASCH, b. 1702, d. 1766. His son, LORENZ PASCH jun., b. 1733, d. 1805, lived at Copenhagen 1754—1757, and in Paris 1758—1766.

<sup>4)</sup> »M. DALIN is readier with his drawings than the others»; »tell him that snakes are hardest of all to deal with». L. to BÄCK, <sup>28</sup>/<sub>11</sub>, <sup>5</sup>/<sub>2</sub>, <sup>9</sup>/<sub>2</sub> 53. — DALIN had been a student of medicine and a pupil of KILIAN STOBÆUS at Lund, where he left in 1727, before LINNÆUS came there. He used to call himself, in jest, the Appelles of Engsö, from drawing and painting being his constant occupation when at Engsö, the estate of his friend Count PIPER. WARBURG, *Svenska Akademiens Handlingar*, LIX, p. 320.

tomologist CHARLES ALEXANDER CLERCK was to paint the exotic Insects. For the shells H. C. v. KRUS<sup>1)</sup> and, it is said, NICOLAS LAFRENSSEN<sup>2)</sup> were engaged. The entire collection of these figures, the joint produce of their talents, now belongs to the library of the Academy of Sciences. The Univalves are represented by 415 figures on forty quarto leaves of vellum, signed by VON KRUS, and, by 35 figures on two leaves in folio executed, as an adnotation indicates, by LAFRENSSEN, all neatly finished *en gouache*. At the close of the year 1754 LINNÆUS requests to have sent to him for numeration the figures then made by VON KRUS, but it does not appear that he had them<sup>3)</sup>. The fifteenth leaf of VON KRUS is dated Febr. 1754, the 26, 27, 30: 1754, the 31 and 32 in October, and the 33, 34 in November that year, the 37 is dated 1755, and the 39, 40 in February that same year. In the same month LINNÆUS was summoned to court to select the Bivalves that were to be drawn. These, it seems, were intrusted to LAFRENSSEN alone, but twenty one figures only were done when the work was discontinued, never to be resumed.

LINNÆUS had sent his MS. of the Museum Regis Adolphi Frederici to the printer in the month of September 1753, and in the same month of 1754 its first part was published<sup>4)</sup>, the well-known folio with thirty three plates. At that time also the MS. of its second part was ready, and the King wished the printing of it to begin early in 1755<sup>5)</sup>. But at that period the political difficulties which had long been imminent, became threatening to such a degree as to avert the thoughts

<sup>1)</sup> HERMAN CONRAD VON KRUS, b. 1720, d. 1787, an officer who had served with distinction in foreign armies, »was engaged to depict the Museum of Queen LOUISA ULRICA». Sv. Adels Attartastor II, p. 516.

<sup>2)</sup> If so, no doubt the elder LAFRENSSEN, a distinguished miniature-painter, father of NICHOLAS LAFRENSSEN jun., b. 1737, the eminent portrait-painter, who lived in Paris 1774—1791, and was called LAVREINCE by the French.

<sup>3)</sup> L. to BÄCK, <sup>31</sup>/<sub>12</sub> 54, and <sup>12</sup>/<sub>2</sub> 55.

<sup>4)</sup> »It is never so well to hammer iron when cold as when red hot. The printing of the King's Cabinet goes so sluggishly that I almost fall asleep over it . . . Dear friend, when the Queen's Cabinet is to pass through the press, I beg you to arrange that I have my hands free, and we will see whether I have not still within me a little of the old fire.» L. to BÄCK, <sup>11</sup>/<sub>12</sub> 53.

<sup>5)</sup> L. to BÄCK, <sup>12</sup>/<sub>11</sub> 54. It will even appear that it was commenced: »Accepi a D:no MOMMA Museum cum tabulis prolusoriis», ib. <sup>13</sup>/<sub>6</sub> 55.



of the Royal Pair from these peaceful pursuits, while the expenses of party-intrigues absorbed the *nervus rerum gerendarum*. The preparations already far advanced were broken off, the artists ceased from their work, and LINNÆUS had to consign his manuscripts to a repose that was to last for years. He became, himself, from that time a rare visitor at the Queen's Museum.

Already early in 1753 LINNÆUS had been able to write to his friends that the *Species Plantarum* was printing<sup>1)</sup>, and in the autumn of that year was published this long-prepared work, on which he had »bestowed all his energies», and which »he always regarded as his best»<sup>2)</sup>. It was followed in 1754 by the fifth edition of the *Genera Plantarum*, and in 1755 by the second of the *Flora Suecica*. And now the order came to the Animal Kingdom of the *Systema Naturæ*. The whole of the year 1756 he was at work at its new edition<sup>3)</sup>, the fourth of his own, called the tenth, »an altogether new work», »without its equal in Natural History», »the sum of all he had seen in this world»<sup>4)</sup>. At the close of the year 1757 the printing of its first part was done, which in the following February he sent to Count TESSIN with the dedication. It comprised »omnes species sibi cognitæ animalium»<sup>5)</sup>. LINNÆUS had all the time counted upon having the two Royal works out, to be referred to for the full descriptions given there of a great number of species. But in this he had been disappointed; their publication had been deferred indefinitely and for years. There is even no indication of their author having had an opportunity offered him of examining anew the original specimens in the Queen's Museum, where strange faces and perhaps a cool reception awaited the friend of a fallen Minister. »Ever since it pleased Your Majesty», he writes in a memorial some years later, »now more than ten years ago, to intrust me with describing the matchless collection of Insects and Shells at Drottningholm, these descriptions have

<sup>1)</sup> L. to WAHLBOM <sup>13</sup>/<sub>21</sub>, to BÄCK <sup>13</sup>/<sub>4</sub> 53.

<sup>2)</sup> Egenh. Anteckn., p. 54, 78.

<sup>3)</sup> Ib. p. 56.

<sup>4)</sup> Ib. p. 58, 70.

<sup>5)</sup> L. to BÄCK, <sup>11</sup>/<sub>11</sub> 56, asking him to revise the printed sheets; <sup>30</sup>/<sub>12</sub> 57: printing finished. — L. to TESSIN <sup>10</sup>/<sub>2</sub> 58, with the dedication copy. ÄHBLING, l. c. p. 45.

<sup>6)</sup> Egenh. Anteckn., p. 56.

been lying by me in a dark box»<sup>1)</sup>. Under such circumstances, and while conscientiously regarding himself in duty bound to keep their essential part, the elaborate descriptions, strictly to himself in trust for the intended Royal publications, LINNÆUS introduced all the species of the M. L. U. into the *Systema Naturæ*, under final binary denominations, with their »differentiæ» only, but amplified and revised, and with the references to preceding authors.

»I never can believe», he writes in 1759, »that the second part of the King's Museum will come out.» He is no longer so anxious to see the Testacea of the Queen's Cabinet published, since KRATZENSTEIN'S great work had now appeared, but is highly pleased with the news that, on his solicitation »when the Queen was at Upsala», CLERCK is to begin figuring the Butterflies<sup>2)</sup>. It seems, however, that even this partial progress was soon cut short, and that CLERCK was permitted to make use of the figures for his own private work<sup>3)</sup>. At last, early in 1763, perhaps somehow in consequence of this deviation from the original plan, LINNÆUS, being out of patience, asked and obtained the Queen's permission to have published privately the Museum without the plates, in octavo, as a prodrome. »The new edition of the *Species Plantarum* is now completed, then come the Genera, and after them the *Museum Reginae* that I may get rid of the descriptions in the new edition of the *Systema Animalium*»<sup>4)</sup>. »If I could have been permitted to have the Insects in my own Museo, it would have been much better; now I give whatever I was able to bring together; if I do not, the world will have nothing of it»<sup>5)</sup>. »In six weeks I hope to have the Genera ready from the printer, and then I shall immediately begin with Her Majesty's Cabinet, as I was lately promised when You were present. If it is not done in my life-time, it will never be done, and it is in vain to wait for the plates, as their Majesties are daily more and more beset with sorrows and anxieties. It would be a loss to science if it were not pu-

1) The original, dated 17/1 64, written from dictation but signed in LINNÆUS' own hand, is in the library of the Caroline Institute. The »ten years» are counted from his last scientific visit to the Queen's Museum in September 1754.

2) L. to BÄCK, 16/7, 31/7, 59; 22/2 60. L. to CLERCK 16/7, 3/8 59.

3) *Icones Insectorum Rariorum*, I, Holmiæ, 1759, II, 1764.

4) L. to BÄCK, 27/6 63.

5) L. to BÄCK, 12/9 63.

blished. I am going to have it printed in octavo; if on some future day the prospects should have become more favourable, it may then be published splendidly, in folio, and with plates. The manuscript is neatly copied and quite ready. But, alas! how difficult it is to publish anything when absent. I made the descriptions as accurate as possible at the time, and now so many books have appeared and I cannot compare the specimens. It is also one thing to write in one's own study, and quite another to write at court. Could I have the insect-cabinets sent here while the work is printing, all would be better, much better, but I cannot make up my mind to ask for them, although I will pledge my soul and honour that not a feather should suffer damage. I fear, moreover, that no small part of their contents is spoilt already, for who is there now to look after them and take care of such a thesaurus, and see that it does not fall into decay through moth and rust<sup>1)</sup>.

LINNÆUS now lost no time to have the neatly penned copies of his schedules ready for printing, and to add some references not introduced when the primitive MS. was closed in 1752. But only a few found place: KLEIN'S *Tentamen Methodi ostracologicæ* of 1753; BROWN'S *Jamaica* of 1756; GINNANNI'S *Opere postume* of 1755; ADANSON, *Sénégal*, 1757; SEBA, *Thesaurus*, III, 1758; BASTER, *Opuscula*, 1761, — but, as one cannot fail to have remarked, generally the references given in the M. L. U. of 1764 are much fewer than those given in the S. N. ed. 10, of 1758.

The printing was commenced early in 1764<sup>2)</sup>. The first sheet A, is that beginning with the page having only the words: Pars I, *Insecta exotica*, and after the last species of the genus *Julus* p. 462, there follows a second title-page: Pars II, *Testacea*. It seems that the printing had advanced up to that point and perhaps beyond it, when it became a matter of consideration what title should be given to the work. Among the schedules preserved there is one, a copyist's transcription cancelled by LINNÆUS, on the back of which is seen, in his hand, the title as then intended: »*Museum Reginae S:æ Ludovicæ Ulricæ etc., sistens Insecta exotica et Conchilia pulchriora in Arce Drotningholmensi asservata, descripta a CAROLO A*

<sup>1)</sup> L. to BÄCK, <sup>14</sup>/<sub>10</sub>, 63.

<sup>2)</sup> L. to BÄCK <sup>7</sup>/<sub>1</sub>, 64.

LINNÉ, Equ. aurat., Archiat. Reg., Professori Upsaliensi, Acad. Paris. Soc. etc.» Professor AURIVILLIUS<sup>1)</sup> has already remarked that this must have been written at least as late as after 1762, as LINNÆUS was elected foreign Associate of the French Academy of Sciences, as BRADLEY'S successor, on the eighth of December that year<sup>2)</sup>. He also signs his name: A LINNÉ, as nobilitated. But the rank of a nobleman conferred upon him by the King as early as in November 1756<sup>3)</sup>, was not confirmed, as was the case with many others, by the then all-powerful Diet until in the month of August 1762<sup>4)</sup>. In January of the following year 1763 he signs himself CARL VON LINNÉ<sup>5)</sup>, and the dissertation de Raphania, ventilated  $27\frac{1}{5}$  63, is in fact the first among his printed works which bears his new name. Consequently it may be assumed that the projected title-page above mentioned dates from 1763, or perhaps even from 1764. It gave the contents of the work probably as they were originally determined upon by the Queen. It is, however, not the one finally adopted, which has: »Animalia rariora exotica imprimis Insecta et Conchylia», indicating that the work contained, besides the principal matter: Insects and Shells, also other rare animals. The reason of this was that during his visits to Drottningholm in 1751, 1752 and 1754, LINNÆUS had described not only the Insecta and the Testacea, but also the Starfishes and Echini of the Queen's Museum, and now, as it will appear while the printing was going on and rather late, may be even after writing down the dedication, decided to have these also published in the M. L. U.; and thus it happened that a third title-page, with »Pars III, Vermes», was inserted after the Testacea, inconsistently with systematic order, the latter properly being subordinate to the former. »The Corals and the Minerals I leave to another day», says LINNÆUS

1) Recensio Critica Lepidopterorum, p. 5.

2) Eg. Anteckn. p. 60.

3) Ib. p. 57. The royal charter was dated  $7\frac{1}{4}$  57. L. to TILAS,  $23\frac{1}{7}$  70.

4) By the three lower Houses only, and in spite of the protestations of the fourth, the House of Nobles, which insisted on its privileges. See MALMSTRÖM: Sveriges historia under frihetstiden, V, p. 219, 221, 224. LINNÆUS was afterwards in due form »introduced» as a member of the House of Nobles. In 1760 he had written to Count TESSIN: »The King nobilitated me with a legion of others; if I am rejected along with the plurality of them, my ambition will not feel hurt, but if with only a few, I shall resent it.» ÅHRLING, CARL V. LINNÉ'S Svenska arbeten, Första Afdelningen, I, p. 63.

5) L. to BÄCK,  $20\frac{1}{1}$  63.

in the preface, and with the Echini and Asteriæ concludes the *Museum Reginæ*. In the middle of July 1764 the last sheet of it was in type<sup>1)</sup>, and the 30th of that month is the date of its Latin preface.

Thus appeared, at last, »as a prodromus»; the work to which LINNÆUS had long looked forward as towards a commentary on the Insecta and Vermes of the *Systema*, giving the full descriptions necessary for a true conception of a great number of their then known species. Out of the 586 species of exotic Insecta in the S. N. ed. 10, 1758, it contained 373, with 87 additional species; of its 703 Testacea, 431, and of the 29 Echinoderms, 24 species. Though in reality the prior work it had, from accidental circumstances, become the later publication, and when its time arrived was still denied the final revision. It was sent forth with some haste, and not without some words implying an apology.

A short prodrome to the second unpublished volume of the *Museum Adolphi Frederici Regis* was appended, giving a selection of its most remarkable specimens. The publisher of both works was LAUR. SALVIUS in Stockholm.

From the autobiography of LINNÆUS we learn that posteriorly to the publication of the M. L. U. he was twice summoned to Drottningholm: in the summer of 1766 »to arrange for the last time the Queen's Cabinet», and in June 1770 »to put in order the new acquisitions»<sup>2)</sup>. Perhaps these Royal summons were conferred mainly for the sake of appearance; they seem to have led to very little scientific result. The time of the former visit coincides with the preparing for the press of the second part of the first volume of the S. N. ed. 12, comprising the Evertbrates; the latter visit perhaps was connected with the intended new edition of the zoological part of that work, concerning which he wrote to his friend BÄCK some years afterwards that he had the whole of it ready, except the second class, the birds<sup>3)</sup>.

LINNÆUS died on the tenth of January 1778. In the ensuing summer the *Museum* of the late KING ADOLPHUS FREDERIC, deceased in 1771, was removed from Ulriksdal to Drott-

<sup>1)</sup> L. to BÄCK, 10/7 64.

<sup>2)</sup> Egenh. Ant. p. 62, 63. L. to BÄCK, 12/6 70. L. to TILAS, 23/7 70.

<sup>3)</sup> L. to BÄCK, 1/6 75. AHLING l. c. 457.

ningholm and united to the Museum of that palace<sup>1)</sup>, which in the foregoing year had passed from the possession of the Queen Dowager to that of her son GUSTAVUS the Third. For many years the collections remained there, and nothing is known regarding them until in 1789, on the recommendations of LEOPOLD, the poet, OLAUS SWARTZ, the eminent botanist, was appointed to take care of them, »a kind of confidential appointment without title or salary»<sup>2)</sup>. This seems indeed to have been intended as a temporary arrangement only, since SWARTZ soon began to hear of the necessity of having the Museum removed to some other place, and various rumours came to his ears about its future destiny. It was, however, not until long afterwards that GUSTAVUS IV ADOLPHUS, who in 1792 had succeeded to the throne, in June 1801 presented the Academy of Sciences<sup>3)</sup> with the collections that once had formed the Museum of his Grandfather ADOLPHUS FREDERIC, consisting almost entirely of Vertebrates, for the most part preserved in spirits. In the month of the ensuing July they were transferred to the buildings of the Academy, and have now for sixty years, together with the whole of her former collections, been incorporated with the Swedish State Museum in the capital.

Two years later the same King made a donation to the University of Upsala of the Museum of his Grandmother, LOUISA ULRICA, consisting of »insects, shells, corals, parts of animals, plants, samples of wood» and minerals, »together with the cabinets, consoles etc.», and on the 6th of June in 1803 the Rector of the University could report to its Council<sup>4)</sup>, that the collections had arrived in a vessel on the lake Mälaren, and had been transferred to the buildings of the Museum in the Botanical Garden under the superintendence of Professor THUNBERG, assisted by Mr GEORGE WAHLENBERG M. A., the subsequently eminent botanist. Once under the charge of THUNBERG these collections were taken care of in a most exemplary manner, and have been preserved by

<sup>1)</sup> BÄCK, in his oration in memory of LINNÆUS before the Academy of Sciences,  $\frac{5}{12}$  78.

<sup>2)</sup> SWARTZ to THUNBERG,  $\frac{18}{6}$  89. — PONTIN, Saml. Skr. I, p. 187. — WIKSTRÖM, Adnot. quæ reliquit OL. SWARTZ, p. XXXVI.

<sup>3)</sup> Minutes of the Council of the Academy of Sciences  $\frac{20}{6}$ ,  $\frac{8}{7}$  1801. K. Vet. Akad. Nya Handl., XXII, 1801, p. 352.

<sup>4)</sup> Minutes of the Consistorium Academicum  $\frac{6}{6}$ ,  $\frac{13}{6}$  1803.

his successors with the outmost scrupulousness, up to the present day.

It may be regarded as an ascertained fact that LINNÆUS never marked with labels of any kind whatever the specimens he described in the two Royal Museums. The only indication he gives that might serve as a clue to their identification independently of diagnosis and description, lies in these words of the Swedish dedicatory preface to the M. L. U. . . . »The short descriptions that I have drawn up of Your Majesty's Natural History Collections, Insects as well as Shells, disposed according to the order in which they were arranged.» He would not have written this, had he named the specimens. And, surely, if there had been labels in LINNÆUS' own hand, no one would have been found presumtuons enough to reject them or to exchange them for any other.

BÄCK in his oration of 1778 already quoted says, alluding to the two Royal Museums: »All who take an interest in the present and future state of Natural History in our country will hear with pleasure that both collections are now preserved at Drottningholm, and that they are kept in the same order, in which LINNÆUS arranged them; according to the published descriptions, the whole marked with his names.» As the matter stands these last words cannot by any means be understood to signify: names written down by LINNÆUS himself, but simply species-names made out from his descriptions. This had probably been done by some person employed for the purpose and through the agency of BÄCK, by the orders of the Queen Dowager, who on vacating in 1777 the handsome residence that had been hers since 1744, very naturally may have wished to leave her Museum, one of its treasures, arranged in a becoming manner<sup>1</sup>).

Be this as it may, no trace is now left of these names. SWARTZ, in his letters to THUNBERG about his doings at Drottningholm, nowhere alludes to any names found there, not even when he<sup>2</sup>) sends him sheets of names of species extracted from the twelfth edition of the *Systema Naturæ*, which he

<sup>1</sup>) ERIC AF SOOTBERG, private Secretary to the Queen, in a letter to GJÖRVELL, <sup>10</sup>/<sub>12</sub> 79, relates how anxious she had been to have every thing in order. He had been compelled to have catalogued within a fortnight the manuscripts delivered in 1777.

<sup>2</sup>) SWARTZ to THUNBERG <sup>29</sup>/<sub>2</sub> 90.

had got printed, and with which he labelled the whole, the insects excepted, »a method», he adds, »of saving labour in a collection not yet finally arranged.» It will appear as if SWARTZ, the botanist, thus avoided the risk of naming in his own handwriting objects among which he did not feel at home.

Lastly there is the testimony of THUNBERG, himself a disciple of LINNÆUS and intimately acquainted with the handwriting of his master, declaring that when he took charge of the Drottningholm collections after their arrival at Upsala, he had searched with the most scrupulous care for a name or anything written by LINNÆUS himself, but without discovering a trace of any sort, »except the printed labels which Professor OLAUS SWARTZ had recently pasted on the shells.» Many years ago also WAHLENBERG, who took an active part in these proceedings, affirmed to the writer of this that LINNÆUS most certainly had not labelled the Queen's collection<sup>2)</sup>.

It may therefore be taken as an established fact that LINNÆUS never deposited any names in the collections he described at Ulriksdal and Drottningholm, but simply arranged the specimens in the same order with the descriptions reserved for the Royal works. It may be readily believed that the danger of the labels getting astray and thus giving rise to worse confusion, appeared to him great enough in the Queen's cabinet, the more so as, probably from experience, he had come to the conviction that »Potentates have none but dons for servants»<sup>3)</sup>. So he relied on his descriptions.

The manner in which the Shells and Echinoderms were kept in the Queen's Museum at Drottningholm is now no longer known, but very possibly it was the same in which they are still kept, and which, in that case, has been adopted by THUNBERG for the shells of the later donation of King CHARLES the XIII and for those of the University Museum. It is the following. Nearly every single specimen is contained in a square box of convenient size, made of strong paper, and filled with cotton on which it lies attached with glue. The Drottningholm specimens are accompanied by slips of paper

<sup>1)</sup> Address at the Inauguration of the new Museum at Upsala, <sup>25</sup>/<sub>1807</sub>, p. 67.

<sup>2)</sup> The statement to the contrary given in the *American Naturalist*, XXI, p. 410, is entirely groundless.

<sup>3)</sup> Dedication to the Queen of the M. L. U.



marked in the handwriting of THUNBERG: »*Mus. Gust. Ad.*», and made to adhere in the same manner, while upon the specimen itself, or more rarely upon the cotton<sup>1)</sup>, is pasted one of SWARTZ's printed labels with a Linnæan name from the twelfth edition of the *Systema Naturæ*; in a few exceptional cases this is lying loose on the cotton. Often also this name is repeated on a slip of paper in THUNBERG's hand.

In this state the entire collection of Shells and Echinoderms brought from Drottningholm to Upsala, has been guarded, intact and undisturbed, during more than eighty years, a case of rare occurrence in any Museum.

And thus I conclude the attempt I have made to follow the Museum Reginae from its origin, as a fancy, in a Royal palace, to its final repository as a precious relic of LINNÆUS, in the University he adorned. It only remains for me before leaving this part of my task to express my obligations to the gentlemen who have given me their friendly aid, with many a kind service and useful suggestion. To my esteemed friend of many years, the learned Librarian of our Academy of Sciences, Mr. J. A. AHLSTRAND, I owe sincere thanks for the numerous opportunities he gave me during the writing of this opusculum of admiring his well-known skill as a trusty guide to sources of information otherwise easily overlooked. To Dr. EVALD ÅHRLING who by his labour of love for many years and his unremitting assiduity has been doing so much to elucidate the scientific life of LINNÆUS, I am greatly indebted for his liberality in giving me access to eligible parts of his ample stores of collectanea. I also have to offer many grateful acknowledgments for much valuable information: to Dr. C. G. STYFFE for his kindness to procure from the State Archives some most welcome extracts; to Dr. H. WIESELGREN of the Royal Library, and Dr. ANNERSTEDT of the University Library at Upsala, for their obliging readiness in affording me the perusal of important manuscripts; and to Dr. M. B. SVEDERUS and Dr. HJALMAR THEEL of Upsala, who took great pains in searching out and transcribing for me documents of particular interest.

<sup>1)</sup> This circumstance seems to speak for the supposition that the boxes with cotton existed already when SWARTZ affixed the labels, that is: at Drottningholm. THUNBERG found the labels »pasted on.»

## II.

**The Linnean species of Echinoidea.**

The third part of the *Museum Ludovicæ Ulricæ*, which treats of the genera *Asterias* and *Echinus*, although it appeared in 1764 as a late additament to the S. N. ed. 10, 1758, existed like the other parts of that work, as a manuscript, at least as early as the summer of 1752. This is obvious from the manner in which those two genera are introduced in the Lectures, so often quoted, of the autumn of that year. »The Archiater, one of his hearers writes, »having had an opportunity of seeing a number of species of *Asterias*, has divided them into *Radiatæ* and *Stellatæ*». Then come seven species, six of them with diagnoses all but identical with those of the corresponding species in the M. L. U., where they are named *Asterias pectinata*, *A. ophiura*, *A. glacialis*, *A. rubens*, *A. aranciaca*, *A. quadrifida*, and a seventh, probably lost afterwards: »radiis octo, alterius lateris brevissimis, COL. Aquat. t. 8, vulgo Cometa.» »These are the known species of this genus; they are all in the Queen's Museum.» In the M. L. U. three more were added: *A. Caput Medusæ*, described in the *Museum Regis*, and *A. reticulata* and *A. lævigata*, both from that of Count TESSIN.

Of the Echini it is said: »In the Queen's Cabinet there is a considerable collection of these, from which, and from what the authors have relating to them, the Archiater has made out the species here following.» These are fourteen, the same that made the original set of the genus in the Drottningholm Museum, the species 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16 of the work of 1764, the numbers 10 and 14 being later acquisitions.

Out of these sixteen species of the M. L. U. six are missing, while ten are present, in the collection preserved in

the University Museum at Upsala. They are represented by seventeen specimens, one species being extant in five specimens, one in three, and one in two, while seven species are single. Besides these ten there are five additional species, not described by LINNÆUS, and some of which he probably never saw, represented by seven specimens. Thus there are in all fifteen species in twenty four specimens, all authentic, labelled by THUNBERG: »Mus. Gust. Ad.», that is from the Queen's Cabinet at Drottningholm. They are also distinguished by the printed labels bearing Linnean names which in 1790 were distributed by SWARTZ, with little pretension to accuracy. The list of the whole, prepared by THUNBERG on its arrival at Upsala, is still extant. It accords very nearly with the present state of the collection as detailed above. THUNBERG, who, like his friend SWARTZ, certainly never had given any special attention to the Echinoids, seems to have accepted without hesitation the random determinations indicated by the printed labels, but for all that his list has no small value from the remarks he very prudently added regarding the condition of the specimens at the time when he took charge of them, if denuded or with spines, entire or broken or even fragmentary, remarks that hold true to this day and not a little help to identify the specimens, while at the same time they attest the good care that has been taken of the collection ever since.

The liberal offer kindly made me by my friends Professors LILLJEBORG and TULLBERG, to place at my disposal for any length of time these precious relics of the Drottningholm Museum, and the existence near at hand of notes on these very specimens dictated by LINNÆUS himself almost immediately upon finishing their description, and which even on the first inspection promised to be of great aid in meeting certain defects of the printed volume, all this was inducement enough for me to undertake the task of clearing up the hitherto neglected synonymy of the Linnean species of Echinoidea, and eventually to restore, where necessary, the denominations given them in the *Systema Naturæ* ed. 10, 1758, the zoological *ab Urbe condita* of binominal chronology.

It can also hardly have failed to be remarked that unlike the other writings of LINNÆUS, which were widely spread in numerous editions, his *Museum Ludovicæ Ulricæ*, less accessible

perhaps from the first, has remained little known and has been even totally neglected by great authorities, who thus missed the very source of authentic and definite information on a great number of Linnean species of Invertebrate animals.

MARTIN HOUTTUYN, a M. D. of Leyden who between 1761 and 1773 published in eighteen volumes a Natural History of Animals according to the system of LINNÆUS and in its fourteenth volume treated of the Echinoids, evidently did not know of the existence of the M. L. U. But, nevertheless, by doing his best to make out the species from the short diagnoses of the S. N. ed. 12 alone, he succeeded in identifying two species that, like most of the others, escaped subsequent describers. His work was all but ignored by LESKE, the Leipzig Professor who in 1778 re-edited KLEIN's book of 1734, with numerous commentaries, the well-known »Additamenta». Alone out of many successive authors he had before him, all the time, the Museum Ludovicæ Ulricæ. But in the old age of its author there had arisen in some quarters a movement of reaction against the powerful influence he had exerted<sup>1)</sup>, and of this feeling LESKE seems to have partaken in no small degree. His efforts to understand the descriptions in the M. L. U. were very slight, while he did his best to procure validity and apparent priority to the phrases of KLEIN, by shortening them where needed into binary denominations. In so doing he was bound, before all, to identify with due exactness the species these phrases belonged to. But KLEIN's collection was not accessible to him<sup>2)</sup>, and so he resorted to the hazardous expedient of searching those of his friends, LINCK, TRIER and the PRINCE of SCHWARZBURG-RUDOLSTADT, for specimens answering to the very indifferent figures he commented on. In this he often was unfortunate, and thus happened to describe under Kleinian names species this author never had known, and which can now but rarely be made out from LESKE's own descriptions. Thus obscured the Echi-

<sup>1)</sup> Nota nimis sunt atque agnita, tot tantisque malevolorum detractorum in divos quoque manes insurgentium obtreactionibus non extenuata, immortalis viri . . . merita». GMELIN, S. N. ed. XIII, Ratio editionis. — CARUS, Gesch. d. Zool. in Deutschland, p. 479.

<sup>2)</sup> KLEIN, b. 1685, d. 1759, in 1740 sold his collections to the Margrave of Brandenburg-Culmbach, who transferred them to his palace at Bayreuth, from where they came to the University of Erlangen, instituted 1743. See D'ARGENVILLE, ed. 1742, p. 217. — Nova Acta Eruditorum Anni 1772, p. 557. — V. CARUS, l. c. p. 458.

noids of the *Museum Ludovicæ Ulricæ*, a work regarded by its author as an indispensable supplement to the *Systema Naturæ*, were totally neglected, even by GMELIN, the Göttingen Professor who, with the assistance, for the Vermes, of the eminent Dane OTTO FREDERIC MÜLLER, in 1788—1793 compiled its posthumous 13th edition, »aucta, reformata». At the best the diagnoses of 12th edition are transcribed, with their errata, which partly at least might have been easily corrected from the M. L. U.; the descriptions of this work are nowhere to be seen, but in their places other descriptions not from nature, but borrowed from various authors and referring to different species; and, worst of all, even diagnoses are arbitrarily altered, by the suppression of important terms, or the insertion of others, in order to fit them to species never had in view. In this state the elucidation of the Linnean Echinoids devolved on LAMARCK who seems to have known even the *Systema Naturæ* mostly at second hand through the 13th edition, and all the time, 1801—1822, was unacquainted with the *Museum Ludovicæ Ulricæ*<sup>1)</sup>, as were also BLAINVILLE<sup>2)</sup> 1825—1834, and DESMOULINS<sup>3)</sup>, 1835—37. And no more was it known to GRAY, 1822—1855, L. AGASSIZ, 1836—1847; DESOR, 1846—1858; PETERS, 1854; v. MARTENS, 1866; ALEXANDER AGASSIZ, 1864—1874; TROSCHEL, 1872, and others, to the present time. But DÜBEN and KOREN made occasionally use of it, 1846, LÜTKEN 1863, and BÖLSCHE 1865.

Deprived of the guidance to a true conception of the Linnean species of Echinoids solely to be derived from the *Museum Ludovicæ Ulricæ*, the authors, from GMELIN to our days, have had recourse to the diagnoses of the S. N. and its references to figures contained in the works of preceding or contemporary naturalists. The diagnoses, extracted from the descriptions and adapted towards distinguishing from one another

<sup>1)</sup> It will appear as if it did not even then exist at the Museum in Paris. CUVIER in his »Regne Animal» of 1817, IV, p. 138, enumerates it among the writings of LINNÆUS, but probably without having seen it. For under the Museum Adolphi Friderici, fol. 1764, he adds: »LINNÆUS cites a second part of this work, which never appeared». It had been published, however, conjointly with the M. L. U., and could hardly have escaped CUVIER's attention, had that volume come into his hands. In the R. A. of 1830 this mistake is corrected.

<sup>2)</sup> BLAINVILLE once quotes »Mus. Lud. Ulr. 707», evidently from GMELIN. Dict. Sc. Nat. XXXVII, p. 77.

<sup>3)</sup> DESMOULINS conscientiously enumerates in a separate column the books he could not consult, among them the S. N., ed. 12 and the M. L. U.

the seventeen species of the genus *Echinus* which LINNÆUS actually had before him, were entirely insufficient when it became a question of discriminating these from numerous new species unknown to him. Then his references to figures were resorted to, and to an extent he never had foreseen. When in 1751 and 1752 he first drew up his descriptions in the Queen's Museum, he referred almost exclusively to such figures of Echinoids in the works of D'ARGENVILLE, GUALTIERI and RUMPHIUS, as seemed to come more or less near to the specimens before him, and these figures he pointed out to his hearers when shortly afterwards he lectured on the Echinoids. Later, while preparing for the press the S. N. ed. 10, 1758, the M. L. U. 1764, and the S. N. ed. 12, 1767, when he had not seen the original specimens for years, various books new to him on Echinoids had come to his notice, and he appended from time to time references to the figures they contained, some as exhibiting the typical species named and described, but others as merely indicating other species apparently more or less allied, which he thus placed on record, to be considered at another time. Great as were his demands on a Natural History draftsman<sup>1)</sup>, he very rarely enjoyed the advantage of meeting with satisfactory drawings, — least of all, certainly, of Echinoids —, and had to content himself with very inferior ones from various sources, all more or less incorrect or obscure, some rude, others ornamentally affected, none of them representing with due exactness the essential distinguishing characters pointed out in the description. He had to take them such as they were, and thus those lists were brought about which are placed next to the diagnosis and enumerate notes and figures of various authors illustrating, some of them the species in question, others allied species formerly seen, or never seen, by him. It follows that these lists were never meant to be lists of synonyms.<sup>2)</sup> For such they have, however, been taken, and many a Linnean species has in consequence been regarded as an aggregate of several different species, and marked as such by means of »*p.*» or »*p. p.*», »*pars*», or a »*pro parte*». To speak here only of the species of the

<sup>1)</sup> Pictor, Sculptor et Botanicus æque necessarii sunt ad figuram laudabilem. Si alter horum peccet, evadit figura vitiosa. Phil. Bot. p. 263.

<sup>2)</sup> Synonyma sunt diversa Phytologorum nomina, eidem plantæ imposita. Phil. Bot. p. 250.

M. L. U., there can be no greater error. While in regard to his systematic units, the species, it was generally the great aim of LINNÆUS to introduce as such, above all, forms known to himself from actual observation, it is absolutely certain that of the more than nine hundred species in the M. L. U. every one had in the Queen's Cabinet its prototype from which, to the exclusion of everything else, the description was made. And consequently this alone can guide to its identification. Even in our days, when zoologists have at hand really skilful artists, it is still an unsafe method to determine species from figures alone, and wherever a discrepancy occurs, the decision ought to lie with the words of the authors own description, not with the work of his assisting draftsmans pencil. So much the more, then, is it hazardous to try to make out Linnæan species from the figures he quotes, and so much the greater reason is there to attach full weight to his descriptions and to do our best to analyse them so as to understand them thoroughly.

The brevity of the style of LINNÆUS is proverbial. While holding in avowed abhorrence the sort of descriptive style he termed oratorical<sup>1)</sup>; while unerringly observant of the rules of compendiousness he had himself laid down so forcibly<sup>2)</sup>, and always having in ready command the language of strict terminology, he generally attained in the construction of his diagnoses and descriptions that degree of terseness he had so much at heart and characterised in the well-known maxim: »Nomina specifica cito, tuto, et jucunde distinguant species»<sup>3)</sup> His diagnoses and descriptions of the Echini will be seen to come very near this ideal, — the diagnoses, however, in too many instances not until subjected to a critical examination and cleared of some grave errata and perplexing blunders committed by hurried copyists, faults which undoubtedly have had their share in many a misunderstanding, almost unavoidable in the absence of the description. Here the notes from the Lectures in the autumn of 1752 have been of the greatest service. While treating of the Testacea, LINNÆUS, as already

<sup>1)</sup> Phil. Bot. p. 133.

<sup>2)</sup> Pulcritudo artis brevitate[m] exposcit, nam quo simplicius, eo etiam et melius, et stultum est facere per plura, quod fieri potest per pauciora; Natura enim ipsa compendiosissima est in omni sua actione. Ib. p. 228.

<sup>3)</sup> Ib. p. 226.

remarked, dictated the diagnoses partly in Swedish and the »character essentialis» alone in Latin, but as soon as he touched on the Echini and Asteriæ, which were not then destined for the Royal publication, he no longer felt himself in duty bound to any reservation, and freely made use of his late studies in the Queen's cabinet. The notes, taken down by at least two different persons among his hearers from his dictation, give the »nomina specifica» as they stood in the schedules, and conform in giving his very words, thus clearly pointing out the corrections to be made and affording the clue to more than one serious deviation. It was in being transferred, as diagnoses, in 1758 to the S. N. ed. 10 and in 1764 to the M. L. U., that part of these dictations of LINNÆUS became incorrect. Tradition says that he made ample use of his disciples in copying his manuscripts and seeing them through the press. His rather illegible handwriting and impatient ardour, and the hasty printing of the last sheets added at the very close of the M. L. U., seem to go far to account for the deficiencies of the published diagnoses.

As for the descriptions, which have come to us only through the M. L. U., we have no test of their correctness. They have not wholly escaped the dangers of the hurried publication, but it will be seen, however, that generally they are very characteristic, often strikingly so, though assuredly they might have gained in some points, had LINNÆUS been able in after years to revise them with the original specimens before him, and to give them the benefit of second thoughts.

At the time of the Lectures LINNÆUS had not yet begun to apply the binary method of denomination<sup>1)</sup>, and in the notes the genus-name *Echinus* is directly followed by the »nomen specificum», the future diagnosis. But, as already in the first edition of the *Fauna Suecica*, the current »nomen triviale» is also given, below, preceded by a »vulgo» or »is called», as: *esculentus*, *saxatilis*, *Diadema*, *Cidaris*, *Spatagus*, *rosaceus*, *lacunosus*, *operculum*, names, partly from RUMPHIUS, under which perhaps the specimens had come from Holland. They were nearly all adopted in the S. N. ed. 10, 1758, where also new names make their first appearance: *sphæroides*, *millatus*, *atratus*, *reticulatus*, with others supplied by the

<sup>1)</sup> See above p. 30.



pastry of Ancient Rome; Globulus, Gratilla, Lixula, Lucunter, Placenta.

The works of preceding authors<sup>1)</sup> referred to in the Lectures on the genus *Echinus* were: D'ARGENVILLE, *Conchiliologie*, ed. 1742, Pl. 28 (with 12 figures<sup>2)</sup>), GÜALTIERI, *Index*; RUMPHIUS, *Rariteit-Kammer*; LISTER, *Angl.* and SLOANE, *Voyage à la Jamaïque*, II, 1725. In the S. N. ed. 10, 1758 are added the old RONDELET, BONANNI, LISTER *App.* and for the first time the works of KLEIN and BREYN. Both were missing in the otherwise well-stocked library at Drottningholm, they are not in its Catalogue, nor were they among the books transferred from there to the library of the Academy of Sciences. LINNÆUS did not possess them himself, and they were not in the University Library at Upsala<sup>3)</sup> nor in that of CHARLES DE GEER of Leufsta, the illustrious Entomologist. They are nowhere referred to in the Lectures nor in the *M. L. U.* of 1764. But in the S. N. ed. 10, 1758, the Dantzig edition of KLEIN's *Dispositio* 1734 is quoted, and in the S. N. ed. 12, 1767, its French translation of 1754. From some words in the introduction to the Lectures on the Echinoids, (1752), it follows that LINNÆUS already then had seen BREYN's *Schediasma*, whose method he finds absurd. For all appearance LINNÆUS had for the occasion borrowed from somewhere the works of these two authors. In the *M. L. U.* of 1764 SEBA's *Thesaurus*, III<sup>4)</sup>, appears for the first time with BASTER's *Opuscula* subseciva, and the old works of IMPERATI and GINANNI are added.

On the geographical distribution of the Echini he described LINNÆUS had none but very inadequate information. The first set, from Holland, of thirteen species, appears not to have been accompanied by any labels giving the habitat, at least the Lectures of 1752 have for none only among them the statement: from the East Indies; and while in the *M. L. U.*

<sup>1)</sup> See above, p. 34.

<sup>2)</sup> In the edition of 1757, quoted by LAMARCK, it is Pl. 25, in which the figures are otherwise numbered, one figure replaced by the *Echinus atratus* L. and two by *Chitons*.

<sup>3)</sup> WAHLENBERG asks for the loan of KLEIN's book in a letter to SWARTZ, 17/11 1815.

<sup>4)</sup> Received late in 1760: L. to BÄCK 12/12 60. — SEBA, b. 1665, died 1736. All the plates of Vol. III were then engraved, but were not published until 1758.

nearly every species of the Insects has its habitat, there is not one such for the whole of the Testacea and the Echini. Possibly, however, LINNÆUS had got a general notion that those thirteen Dutch Echini were from the Eastern Seas; for in the S. N. ed. 10 published in the meantime, ten of them are said to inhabit the Indian Ocean or the Southern Seas, one the whole Ocean, one the »M. Mediterraneum», which I strongly suspect to be a slip for »M. meridionale», and one has no habitat. The collections in Holland abounded in East Indian species and it will be seen that those Dutch specimens probably all of them were from such of the tropical parts of the Old World where Holland had settlements. The two later additions, the N:o 10 and 15 of the S. N., 10 and 14 of the M. L. U., are American species, though only one of them is marked as such. The distribution throughout the seas, of the little known Echini, was in those days, generally, very vaguely attended to, and LINNÆUS who in that respect treated the species, described as well as only referred to, rather summarily, did not even hesitate to attribute to one or the other a world-wide range. He also relied too much on other authors, and was occasionally deceived.

It was on the basis of a passing examination, three years before, of an Echinus brought fresh from the sea, and on that of his late studies in the Queen's Cabinet on thirteen other species; that LINNÆUS in the autumn of 1752 demonstrated to his hearers the principal characters of the genus. In the notes taken by MENNANDER<sup>1)</sup> in 1733, the sixth Class bears the name of »Zoophyta» and its third Order begins with Echinus, »subrotundus, undique aculeis stipatus; has five teeth in the mouth which close like the valvulæ of a fruit», and Asteria, »which

<sup>1)</sup> When LINNÆUS on his way back from Lapland late in the autumn of 1732 reached Åbo in Finland, he found himself out of pocket, and was supplied with necessary means by giving lessons in Natural History for a week to CHARLES FREDERIC MENNANDER, a student five years his junior, and in the following year one of his hearers at Upsala. LINNÆUS and ARCTÆDIUS, afterwards ARTEDI, »both at the same time began to study fishes and insects, but as LINNÆUS could not keep pace with ARTEDI in the fishes, he left them to him, while ARTEDI gave up the insects to LINNÆUS», Eg. Ant. p. 19, 20. After the notes from the lectures of LINNÆUS, MENNANDER wrote down a memorandum on the rules for rightly observing the characters of fishes and these words: »Hæc pler(aque) fr(atri) Arct(ædio) debeo.» In after years, as Bishop of Åbo and at last as Archbishop of Upsala, he always exerted his influence to promote the study of Natural History.

is divided into radios, like a star. In the first edition of the *Systema Naturæ*, 1735; they are placed in that same Order, there called Zoophyta, while Vermes has become the name of the Class; in the second edition, 1740, they have been separated and Echinus removed to the Testacea, but in the sixth, 1748, they are again brought together under Zoophyta. LINNÆUS now in the Lectures declares that the Echini differ from the Starfishes merely gradus, strongly insists upon the diversity between their testa and the concha and cochlea of the Testacea, and, correcting a statement in the sixth edition, points out as of particular importance the mobility of their spines.

Specimens, he says, are most highly valued in which all the spines are preserved. But, in this condition the characters of the species are not to be distinguished, and it has therefore become a general practice to remove the spines by cooking. At that time, all the specimens in the Queen's Museum, perhaps with a single exception, the Echinus esculentus, were thus denuded, and it was for the solid framework, then coming into view, that LINNÆUS created his terminology. Unacquainted, it seems, with RÉAUMUR's observations of 1712, he had, except with regard to the mouth with its teeth and the excretory opening, no distinct idea of the external organs and their functions, and thus preferred to adopt for them insignificant terms having no reference at all to their use in the economy of the animal. The exterior of an Echinus, he said, may be likened to a garden with its beds and walks. The areas convex and broad, are like the beds, the ambulacra are like the walks, between them, impressed and narrow, and these are always perforated very minutely, like a lady's lace.

The special terminology of the descriptions is as follows. The general form of the TESTA is stated, from *E. Cidaris* to *E. Placenta*, as: *globosa*, *hemisphærica*, qualified by the addition of *gibba*<sup>2)</sup> or *depressa*<sup>3)</sup>, which refers to the dorsal centrum; *planiuscula*, *plana*. In the *Echinometræ*, the *Spatangi*,

<sup>1)</sup> S. N. ed. 10, p. 663, note.

<sup>2)</sup> Foliū gibbum, quod utramque superficiem facit convexam. Phil. bot. p. 46, 75.

<sup>3)</sup> Foliū depressum, quod in disco magis deprimitur quam ad latera. Phil. bot. ib., 77.

the Clypeastridæ, the ambitus is: ovatus, ovalis, orbiculatus, sub-orbiculatus.

The »Centrum» of the dorsal surface, »cum area pentagona angulis perforatis», »apicibus puncto perforatis», »ex punctis 4, 2, perforatis», is the calycinal system with its costals and their sexual apertures. The words, of Clypeaster rosaceus: »ex punctis perforatis minimis in orbem positis», appear to refer to the madreporite. In most of the specimens of the Museum now remaining these parts are missing, from having been destroyed by the cooking process.

The »Basis» is the under side, with the »apertura», the peristome in the »Regulares», or

the »centrum», »foramen centrale» in the »Irregulares», the »centrum reniforme» in the Spatangii.

The »Pori» are the pedicellar pores. In the Regulares he regards them as single and counts them singly, not as geminous and by pairs. He remarks on their arrangement in »series» and in »ordines obliquos». In the Irregulares he observes their structure in the petala, naming them there »puncta perforata», and makes use of the same expression in his special observations on the Echinus Diadema.

The »AMBULACRA» properly answer to what is now called zonæ poriferæ, the fasciæ of LAMARCK and BLAINVILLE. In the Regulares LINNÆUS counts ten ambulacra, which in his fifth species approximate, so as to form five pairs, in the sixth the like, and in the seventh, Echinus Diadema, and the eighth, Echinus Cidaris, become almost contiguous, two and two, so closely as to appear as forming only five ambulacra. In the three last among the Regulares, which are Echinometræ, there are again ten separate ambulacra.

In all the Irregulares LINNÆUS counts but five ambulacra.

The »Radii» are the petala in all the Irregulares. In the Regulares the same term, in the special remarks on the Echinus Diadema, exceptionally refers to the peculiar conformation of the upper part of the »five ambulacra».

The »AREÆ l. AREOLÆ minores», »angustiores», »intermediæ» are the spaces included between two zonæ poriferæ or »ambulacra» L. This space, taken together with the two zonæ, constitutes the ambulacrum of the present terminology, introduced by LAMARCK<sup>1)</sup> and BLAINVILLE<sup>2)</sup>.

<sup>1)</sup> An. s. Vert. III, p. 4, 40.

<sup>2)</sup> Dict. sc. nat. XXXVII, p. 62.

The »AREÆ», »AREÆ majores», »AREOLÆ 5 majores», »latiores», are the five interradia. They are »bifidæ», i. e. consist each of two rows of plates. The »linea lateralis flexuosa», »linea longitudinalis» is their median suture.

The »Puncta semipertusa» are the pits or lacunæ at the angles of this suture in the Temnopleuridæ.

The »Discus» is the middle part of an area major or minor, as distinct from the marginal parts<sup>1)</sup>.

The »Verrucæ» are the primary tubercles when large as in *Cidaris*, *Diadema*, *Heterocentrus*, the area of which are called »verrucosæ». Once only, in *Echinus esculentus*, primary tubercles of minor size are called »verrucæ», but with the qualification: »obsoletæ». Once, in the description of the *E. lucunter*, they are called »tubercula». The »scrobicula» is named basis.

The »Puncta», »puncta callosa», »eminentia», »prominentia», »prominula», »elevata», are tubercles of middle size, secondary, tertiary tubercles, granula; their presence in the area is indicated by »müricata», »submüricata».

It now follows to consider severally the species of *Echinus* described by LINNÆUS. Of each of them I shall give: the original diagnosis, corrected and emended; the references to other works and the figures these contain, which LINNÆUS subjoined from time to time, in the *Fauna Suecica* of 1746 and 1761, in the *Lectures* of 1752, the *Systema Naturæ* ed. 10 of 1758, the *Museum Ludovicæ Ulricæ* of 1764, and the *Systema Naturæ* ed. 12 of 1767; after this will come the habitat, and, lastly, the description, from the *M. L. U.* Having thus placed together, in one connexion, all that LINNÆUS has said in different works on the species in question, I shall duly account for the alterations introduced; and assign the reasons I have had in making them, then comment on the whole of the descriptive part and on the various references, and point out the modern species which coincides with that of LINNÆUS, and which is to take its name:

<sup>1)</sup> Phil. Bot. p. 44, e. Margo est extrema ora folii ad latera, intacto disco folii.

ECHINUS L.

\* *Regulares, ano verticali supra os.*

1. ECHINUS ESCULENTUS L.

ECHINUS hemisphærico-globosus, ambulacris denis, areis obsolete verrucosis.

Fauna Suecica, ed. 1746 et 1761:

*Lister, Angl. p. 169, t. 3, f. 18.* Echinus marinus aculeorum vestigiis parum aut nonnihil eminentibus.

Prælectiones 1752 et Mus. Lud. Ulr. 1764, add.:

*Linnaeus, Iter Scanense, p. 327.*

*Rumph. mus. 31, t. 13, f. B.,* Echinus esculentus.

Syst. Nat. ed. 10, 1758, add.:

*Klein, Echinod. p. 16, t. 9,* Cidaris miliaris.

Syst. Nat. ed. 12, 1767, add.:

*Baster, Subs. 3, p. 112, t. 11, f. 2—8.*

Syst. Nat. ed. 10 et 12:

*Hab. in Oceano Europæo et Indico.*

TESTA hemisphærico-subglobosa, rubra, punctis callosis obsolete adpersa.

AMBULACRA 10 serie multiplici pororum, ordinibus obliquis, in singulo sex.

AREOLÆ majores undique adpersæ verrucis exoletis, ad basin magis prominentibus.

Caret linea lateralis flexuosa ad angulos poris.

AREOLÆ minores, duplo angustiores, similes.

APERTURÆ regularis, subrotunda, nec 10 fissuris notata.

SPINÆ violaceæ, apice albæ.

The series begins with this common northern species, the type of the genus in its modern sense, apparently the largest<sup>1)</sup> of known Echinoids, recent or fossil, and the only one LINNÆUS had seen fresh from the sea. Already in 1746 he had introduced it in the Fauna Suecica with the short diagnosis: »Subglobosus; vertice plano», the reference to LISTER, and the habitat: in oceano Norvegico. In his Travels in Scania, 1751, he relates that when he was at Krapparp, south of the Kullen promontory, on the 14 of July 1749, the proprietor of that estate had ordered that of every kind of marine animals captured during the night a specimen should be brought to LINNÆUS the following morning, and continues, after the notes taken on Fishes and Crustacea:

»The Borre Echinus (Fn. 1289), is caught here frequently, often as large as a child's head, and with orange-coloured spines. It is globose, and not compressed, and when the spines are removed, one sees their »vestigia digesta in areas 5 bifidas; punctis callosis adpersas, lineisque transversis hinc inde exaratas; inter singulas majores areas minor areola ejusdem structuræ. Anus in centro verticis pentagoni apicibus puncto perforati. Os sub basi animalculi connivens quinque dentibus. This creature is never used for food here, but abroad it is much eaten».

In his Lecture in the autumn 1752 LINNÆUS dictated the diagnosis: hemisphærico-globosus, ambulacris denis, areis obsolete verrucosis», which, not long before, he had written down at Drottningholm, and which is seen again unaltered in S. N. ed. 10, 1758, Fn. S. ed. 2, 1761, S. N. ed. 12, 1767. By the description given in the M. L. U., which has been justly called masterly, LINNÆUS carefully distinguishes this species from the two next as well as from the third, all of which might, at that time, have been confounded with it.

<sup>1)</sup> DÜBEN & KOREN measured a Norwegian specimen, 147 mm. in diameter, 115 mm. in height. In our State Museum is a specimen of the Echinus acutus LAMCK, from the west-coast of Sweden, of respectively 137 mm. and 111 mm. In the E. esculentus L. the relation between diameter and height varies greatly. Among 14 specimens taken at random, the diameter in one specimen is 93 mm. and the height 60 mm., or 0,645, while in another of nearly the same size, diameter 95 mm., the height is 86 mm. or 0,90. The average diameter is 102,42 mm.; the height 74,62 mm. or 0,728. The relative dimensions of diameter and height generally have little value as a specific character. Young specimens are always flatter.

Among the Echinoids marked »Mus. Gust. Ad.» no specimen of this species is extant, and from the misplacement on three different species of its printed label it will seem that it was missing already in 1790. There is a small fragment entered as such already in THUNBERG's list, and one entire specimen, both of the *Echinus acutus* LAMCK, as also one of the *E. melo* LAMCK; all, no doubt, additions of a later date, probably from the Museum Regis, and not the types of the description which excludes them by the words: »areolæ majores unigue adpersæ verrucis». It is the only Swedish, indeed the only European species in the whole collection, where it was no doubt represented by a specimen from our west coast, perhaps given by LINNÆUS himself.

*Echinus esculentus* L. is a north- and east-atlantic form, common on the Scandinavian coasts from the promontory of Kullen to Finmark; according to LÜTKEN it reaches as far north as Spitzbergen, and, according to M. SARS, Iceland; to the south, along the coasts of Denmark, Germany, Holland and Great Britain, at least as far as the western coast of France. It lives on a rocky bottom at depths of from 5 to 100 fathoms.

LISTER, the great pioneer, was the first who distinguished this species. Under the appellation of »esculentus» RUMPHIUS comprehended several East Indian species, the eggs of which were reputed eatable, — those of the *Boletia pileolus* seem to have been most relished, — and described the proper mode of dressing them. No figure accompanied his notes, and SCHYNVOET added the figures *A*, *B* and *C* on t. 13, this time not drawn from exotic specimens in the collection of D'ACQUET, but, as it seems, from specimens taken near the Dutch coast, not cleansed by cooking, but with the dried remains of membranes and spinary muscles fringing the tubercles, and with the dental apparatus preserved. It was SCHYNVOET's silence on this subreptive illustration that caused LINNÆUS to give the species a world-wide habitat. With those figures KLEIN confounded the West Indian *Tripneustes ventricosus* LAMCK. The figures given by BASTER, scarcely determinable, are by mistake quoted a second time under the *E. Cidaris*.

The »nomen triviale» adopted for the northern species by LINNÆUS — *quasi lucus a non lucendo* — was retained by PENNANT and FLEMING, and then forgotten. NILSSON already





1758. *Echinus esculentus* L. S. N. 1872. AL. AGASS., Rev., p. 123, 491, t. VIIa fig. 7.
1776. *Echinus Sphæra* O. F. MÜLLER, Z. D. Prodr. p. 235, n. 2845.
- »       »       »       1817. NILSSON, Collectanea Zoologiæ Scandinavicæ, p. 4.
- »       »       »       1841. FORBES, Brit. Starfishes, p. 149.
- »       »       »       1841. AGASSIZ, Mon. d'Echinod., IV, Préface, p. III.

Of the four following species, Nos: 2 to 5, LINNÆUS in his Lecture 1752 said: »They are in the Queen's cabinet, but no author has them, and they are very rare», and in his published works their diagnoses remain unaltered, without any references. Foremost among them he placed two species of the now well-known group of *Temnopleuridæ*, characterised by the presence of »*puncta semipertusa*» at the angles of the sutures, interradial as well as ambulacral. Thus he was the first to perceive an important feature, not realized till long afterwards, at first overlooked then attended to by LESKE<sup>1)</sup>, neglected by LAMARCK<sup>2)</sup>, but found again by BLAINVILLE<sup>3)</sup>, and now a subject of special research.

When the diagnoses and descriptions of Nos: 2 and 3 are compared respectively it becomes evident that an interchange of schedules has taken place. The diagnosis of No. 2 says: »*areis latere muricatis*», while the description has: »*Discus etiam adpersus punctis minoribus prominentibus*». On the other hand the diagnosis of No. 3 has: »*areis undique muricatis*», while the description says: »*Discus longitudinaliter glaber*». To remove this contradiction, probably caused by an inadvertency of the transcriber, it is necessary only to transpose the descriptions, by placing that of No. 3 under the diagnosis of No. 2, and *vice versa*. In this manner the order is restored, as follows:

<sup>1)</sup> Addit., p. 96, 152.

<sup>2)</sup> *Echinus ovum*, *E. pallidus*, An. s. vert., III, p. 48; 1816.

<sup>3)</sup> Dict. sc. nat., XXXVII, p. 82; 1825.

## ECHINUS GLOBULUS L.

ECHINUS hemisphærico-subglobosus, ambulacris denis,  
areis lateribus muricatis: medio porosis.

S. N. ed. 10 et 12.

*Habitat in Oceano Indico.*

TESTA hemisphærico-globosa, nitidissima.  
AMBULACRA 10, serie pororum quadruplici, subtus fere  
repandâ: ad unum, serie pororum quadruplici, subtus fere

AREOLÆ majores ad latera et basin rufæ, muricatæ  
punctis albis prominulis.

Discus longitudinaliter glaber, glaucus, lineola  
flexuosa longitudinaliter insculpta, ad cujus angulos  
puncta semipertusa.

AREOLÆ minores duplo angustiores, cæterum eadem.

The Lectures of 1752 have »lateribus», with this explanation: »has spines on the sides of the elevations», that is: of the interradia.

AGASSIZ recognised the species thus described. It is the only one in its group having the pedicellar pores disposed in such a manner that every zone consists of two longitudinal rows, the outer one of which has its pores farther apart than the inner one. If, after the manner of LINNÆUS, each geminal pore is counted for two, there come forth transverse rows of two pores alternating with rows of four pores. This appears to be the meaning of the words: »serie pororum quadruplici», always assuming the text here to be genuine.

A specimen in the collection, marked »Mus. Gust. Ad.», indubitably is the original type of the description. It is

### Mespilia Globulus L.

*Cidaris assulata* Sp. VI. *Granulata* KLEIN, Disp. p. 21, t. XI, f. *E. F. orig.*, 1734.

1758. *Echinus Globulus* L. S. N. ed. 10, p. 664.

» » » 1764. M. L. U., p. 706.

» » » 1768. S. N. ed. 12, p. 1102.

*Mespilia* » » 1847. AG. DES. C. R. p. 53, t. XV, f. 17. orig.

» » » 1872. AL. AG. Rev., p. 143, 477, t. VIII<sup>a</sup> f. 13, 14; VIII<sup>c</sup> f. 14. orig.

1778. *Cidaris granulata* LESKE. Addit. p. 96, 153, t. XI, f. *E. F. repet.* Klein.

1827. *Echinus punctiferus* VAL., Enc. Méth. I, p. 142, t. 142 f. 1, imit. f. *F. Kleini*.

1827. *Echinus atternatus* BORY, ib. f. 2, imit. f. *E. Kleini*.

The species which BLAINVILLE<sup>1)</sup> with some doubt refers to the *E. Globulus* L., and which DESMOULINS<sup>2)</sup> records under that name as unknown to him, is different.

<sup>1)</sup> Dict. Sc. nat. XXXVII, p. 82; LX, p. 208; Man. d'Act. p. 227.

<sup>2)</sup> Études, p. 274.

3. ECHINUS SPHÆROIDES L.

Tab. 2.

ECHINUS hemisphæricus, gibbus, ambulacris denis, areis undique muricatis: medio porosis.

S. N. ed. 10 et 12.

*Habitat in Oceano Indico.*

TESTA hemisphærico-globosa.

AMBULACRA 10, pororum multiplici serie, in singula poris sex.

AREOLÆ majores ad latera et basin muricatæ punctis majoribus prominentibus.

Discus etiam adpersus, punctis minoribus prominentibus.

Linea longitudinaliter flexuosa insculpta, ad cujus angulos puncta semipertusa.

AREOLÆ minores duplo angustiores, cæterum eadem.

The S. N. ed. 10 and 12 have »hemisphærico-gibbosus», the M. L. U. »hemisphærico-gibbus»; in the S. N. ed. 12, the word »areis» is left out. The Lecture has »hemisphæricus, gibbus», and LINNÆUS added *viva voce*: »has spines all over the elevations». While of the E. globulus it is said: »discus longitudinaliter glaber», it is here stated that the discus of every interradium is strewn with smaller tubercles, while the sides have them larger. The pedicellar pores are three, disposed in transversal rows. The excellent description agrees entirely with a specimen marked »Mus. Gust. Ad.», undoubtedly the type of

**Salmacis sphæroides L.**

Tab. 2, fig. 1—3.

1758. *Echinus sphæroides* L. S. N. ed. 10, p. 664.  
 »           »           » 1764. M. L. U., p. 706.  
 »           »           » 1767. S. N. ed. 12, p. 1102.

TESTA hemisphærica, gibba, ambitu levissime pentagono, diametro 57 mm., altitudine 34 mm., supra æqualiter convexa, subtus modice pulvinata, stomate leviter immerso, subdecagono, incisuris parum profundis.

CALYX: radialia intacta, integra, I et V periproctio vix propioribus, pentagona, miliariis irregulariter ornata fere septem, orbita subquadrata, margini adoralî propiore; costalia modice producta, intus late emarginata et serie prædita verrucarum ad 5 usque, tribus majusculis, additis fere 5 minutis supra foramen sexuale oblongum; cribrum madreporeum minutissime perforatum; periproctium latum, subpentagonum, costalia 5, 1 profundius erodens.

AMBULACRA dimidium interradium latitudine æquantia; assulæ ternariæ, intermedia abbreviata; zonæ poriferæ supra leviter, in basi distinctius impressæ; pori majusculi, septo prominulo, tuberculato, trigemini, ordine brevi obliquo, ad planum verticale angulum formante semi-recto majorem.

VERRUCE exiguæ, primariis conspicuis. Ambulacrorum primariæ confertæ, magnitudine infra primarias interradiatorum, nonnihil intra medium assulæ positæ, per unam utrinque seriem solæ continuæ; secundariæ internæ, in basi minutæ, singula utrinque serie, versus ambitum auctæ, tum fere subito deminutæ, sursum evanidæ; tertiariæ extra pororum par medium; miliarium prope ambitum series interjectæ utrinque binæ l. tres, omnes sursum evanidæ.

Interradiatorum verrucæ subter ambitum subæquales ordine transverso, per series longitudinales utrinque quaternas dispositæ, quarum secunda longe primaria, rariuscula, sola continua; quarta intima, minuta, brevissima; prima externa, et tertia validiusculis, — tribus his omnibus supra ambitum fere subito in granula rariuscula deminutis.

»PUNCTA SEMIPERTUSA», lacunæ strati extimi: media ambulacrorum, in suturæ angulis, subrotunda, a peristomate fere ad

apicem continue distincta; interradiatorum in assulis primis dubus fere nulla, in tertia, septima, aucta, deinde distincta, triangula, apice adorali, superius deminuta. Lateralia duplicis ordinis: majuscula triangula ad suturas interradiatorum, serie fere continua; minora illis interposita tria.—quinque, inæqualia, ad suturas assularum ambulacralium primarias, prope ambitum distincta, superius evanida.

AURICULÆ perditæ.

COLOR sordide viridis, ab ambitu sursum in arcis et areolis mediis obscurus; maculæ albæ: in interradio omni singula subapicalis, sagittata, altera ad ambitum, media, major, fere quadrata; in ambulacris nonnihil supra ambitum tres, elongatæ; media et lateralis utrinque, paulum superior, in zona porifera; quibus omnibus respondent in basi, interjectis maculis subsagittatis obscuris, totidem striæ carneo-albæ a peristomio radiantes.

The peculiar colouring described appears to be characteristic (and a leading feature for the recognition of this species. A young specimen, 17 mm. by 10 mm., from the Macassar Straits, shows very distinctly the identical pattern, the green colour of the upper area and the white spots, which seen from above form a slightly pentagonal figure. The *Salmacis Woodsi* RAMSAY shows the white spots of the interradia, at the ambitus. The specimen is no doubt a deformed one<sup>1</sup>).

Among the species of *Salmacis* described one alone seems possibly to fall under the *E. sphaeroides* L., the one described by LOUIS AGASSIZ<sup>2</sup>), as *S. rarispina*, with characters that, variable as they are and mostly common to the other species, almost leave it to the trivial name alone to give a clue to the species intended. This may be the *S. rarispina* described by ALEX. AGASSIZ<sup>3</sup>), only it cannot well be that «in the interambulacral space above the ambitus» the primary tubercles form «only two continuous vertical rows near to the poriferous zone», and that they are similarly arranged in the ambulacra, — all contrary to the general rule, and to what is seen in the photographs given. With this observation, a specimen

<sup>1</sup>) RAMSAY, Catalogue of the Echinodermata, in the Australian Museum I. p. 47, t. II, fig. 1—3.

<sup>2</sup>) AG. et DESOR, Cat. Rais. 1847, p. 55.

<sup>3</sup>) Revis. p. 475, t. VIII b, f. 4—6.

now before me answers tolerably well to the description and figure quoted, but better still to the description and figure given by JEFFREY BELL<sup>1)</sup> as of a form  $\beta$  of *S. globatrix* AGASS. and afterwards declared by him to be the true *S. globatrix*<sup>2)</sup>. Another specimen, from Moreton Bay, is identical, only all the tubercles are distinctly larger. But neither of the two shows a trace of the peculiar colouring so conspicuous in the Linnean specimen of the *S. sphæroides*, and I, therefore, leave to another day — and to others — to decide on their relations.

The *Salmacis sulcata* AGASS., with the angular pits connected by the transverse canals of the sutures which are intercepted by the primary tubercles, seems to find a more convenient place in the genus *Temnopleurus* AGASS. If I am not mistaken it is described by ALEX. AGASSIZ under *S. globatrix*<sup>3)</sup>, and by JEFFREY BELL as form  $\alpha$  of that species<sup>4)</sup>.

In all the species described the basis is more or less pulvinated; the primary tubercles, decreasing above the ambitus, assume again towards the top a rather prominent form; in the interradia their row is, at the ambitus, the second, third or fourth from the zona, and upwards the two rows become conspicuously parallel, even as if tending to diverge, while the ambulacral ones converge, always bordering the zona. On the ventral side the tubercles are considerably larger and more equal, and the spines stronger, subspatulate, and, as generally, annulated. As in other *Temnopleuridæ* the calycinal system often presents, in the suture between two costals and the radial, a pit like the angular ones of the area; in some specimens, particularly in young ones, it is distinct, in others obscure or wanting. This may be seen in *Temnopleurus toreumaticus*, *Microcyphus foliatus*, *Amblypneustes ovum*, *Salmacis sphæroides*, *S. globatrix*.

There is great confusion among the species of this genus. Without venturing upon any decision I here subjoin the descriptions of four species which seem to hold good:

<sup>1)</sup> Proceed. Zool. Soc. 1880, p. 433. t. XLI, f. 2, 3, 8.

<sup>2)</sup> Proceed. Linn. Soc. N. S. Wales, IX, p. 505.

<sup>3)</sup> Revision, p. 473.

<sup>4)</sup> l. c. p. 433, t. XLI, f. 1, 7.



**Salmacis bicolor** AGASS. C. R. p. 55, t. 15, f. 4. —  
 DESOR, Synops. t. XVII, f. 12. — AL. AG. Rev. p. 471, t.  
 VIIIa, f. 11, 12.

TESTA hemisphærica, subconica, altitudine 0,65, l. 0,57,  
 diametri; stomate in testa depressiuscula aliquantum profun-  
 dius immerso: Specimen non plane adultum.

CALYX costalibus ad basin septemspinosis; radialibus bi-  
 lobis interdum tumidis, ad basin tri-spinosis.

VERRUCÆ ambulacrorum primariæ confertæ, addita in ima  
 basi utrinque serie interna singula, validiuscula, regulari; ver-  
 sus ambitum altera, tertia, dein quarta, his sursum inæqua-  
 liter, deminutis, singula serie apicem petente. Interdum ver-  
 rucæ numerosiores in disco confuse discurrentes, interspersis  
 granulorum seriebus transversis;

Interradiatorum series primaria ad ambitum tertia, l. quarta  
 et vix prævalida, additis duabus, l. tribus, externis, et tribus, l.  
 quatuor internis, subæqualibus, sursum obsoletis. Suturis trans-  
 versis parallelæ series duæ granulorum.

AURICULÆ foramine obovato, arcu lato, margine superiore  
 truncato, medio inciso.

COLOR virescens.

MENSURÆ: diam. 82 mm., altitud. 47 mm.

» 57 » » 37 »

### **Salmacis spheroides** L.

TESTA hemisphærica, gibba, altitudine 0,60 diametri.

CALYX costalibus ad marginem internum quinque-spinosis,  
 spinulis supra porum fere totidem; radialibus bilobis, fere  
 septem-spinosis.

VERRUCÆ ambulacrorum primariæ confertæ, secundariæ in-  
 ternæ, serie utrinque singula, sursum subito deminutæ;

Interradiatorum series primaria conspicua, ad ambitum se-  
 cunda, additis seriebus internis utrinque duabus, sicut externa  
 prima sursum obsoletis.

COLOR sordide viridis maculis ad ambitum albis, areis in-  
 ferne albido radiatis, superne fusco.

MENSURÆ: diam. 57 mm.; altitud. 34 mm.

### **Salmacis globatrix** AG. C. R. p. 55.

TESTA hemisphærico-globosa, basi leviter pulvinata, alti-  
 tudine 0,67 diametri; specimen haud adultum, radialibus fere  
 æquidistantibus, ano a centro parum remoto.

**CALYX** costalibus acervatim septem- l. octo-spinosis, poro oblongo; radialibus pone orbitam trispinosis; in sutura communi punctum semipertusum conspicuum.

**VERRUCÆ** ambulacrorum primariæ conspicuæ; in basi series utrinque singula, addita interna, minuta; disco nudo;

Interradiatorum series primaria prævalida, ad ambitum secunda, addita interna utrinque singula cum externa sursum evanescente, disco longe lateque nudo.

**SPINÆ** basi rubræ dein albæ rubro lineatæ, apice in ventralibus curvato.

**COLOR** cinerascens zonis pallidis.

**MENSURÆ**: diam. 24,5 mm.; altitud. 16,5 mm.

**Salmacis Dussumieri** AGASS. C. R. p. 55<sup>1)</sup>. — AL. AG., Rev., p. 473, t. VIII, b, f. 7, 8.

**TESTA** depressiuscula, basi conspicue pulvinata, stomate profunde immerso. Specimen adultum, radiali I eroso, V periproctio contiguo, membrana anali magna, multipartita, ano postico, prope interradium 5.

**CALYX** costalibus juxta marginem internum tri- l. quadri-spinosis, reliquo lævibus; radialibus muticis, truncatis, fere lævibus, orbita punctiformi.

**VERRUCÆ** ambulacrorum seriei primariæ raræ, in alternis modo assulis obviæ, serie secundaria interna utrinque singula, ad ambitum valida, sursum obsoleta, disco lævi;

Interradiatorum series primaria ad ambitum secunda, parum prævalida, interna singula, cum externa sursum obsoleta, disco fere lævi.

**SPINÆ** albo rubroque annulatæ, basaliū apicibus cavis, viridibus.

**COLOR** testæ virens, areis disco pallidis.

**MENSURÆ**: diam. 31,5 mm., altit. 14,5 mm.

The aspect of the calycinal system and the relations between its constituents are extensively used for specific characters. As such they are, however, of very little value in consequence of the great changes the different parts are subjected to during growth. In a former work<sup>2)</sup> I gave a plate

<sup>1)</sup> In the diagnosis I read »plus serrés» for »moins serrés».

<sup>2)</sup> Etudes s. l. Echinoidées, Pl. XXI. — Se AL. AGASSIZ Embryology of Echinoderms, p. 12, 1863, and Hasler Echinoidea, p. 6.

and its explication to the transformations observed in the *Strongylocentrus dröbakensis*, showing how at first the periproct is distant from the radials, how it widens and encroaches upon the surroundings, how in its backward movement it erodes the costals 1. and 5, until it at last attains the radial I, then the V, while the IV is approached and the II and III are untouched, and how at the same time the anal membrane expands and its ossicles become more numerous, while the excretory opening recedes towards its margin in the direction of I and 5. It remains to examine this process in other genera of the Echinidæ. At present it may be assumed that in this genus and most others a periproct not approaching or attaining the radials I and V, an anal membrane with few and relatively large ossicles, and a sub-central excretory opening, denote the not adult or the young state, while the adult may be known from a periproct eroding the two biviarial radials, and even nearing the IV, by a multipartite anal membrane, and a posterior excretory opening. It is clearly not safe to use as specific characters the different stages of development coming into view between these extremes.

4. ECHINUS GRATILLA L.

ECHINUS hemisphæricus, gibbus, ambulacris denis triplicatis, areis decussatim muricatis, basi decemfissis.

S. N. ed. 10 et 12.

*Habitat in Oceano Indico.*

TESTA hemisphærica, sed magis gibba, basi decem fissuris notata.

AMBULACRA 10, singula muricata et porosa serie triplici; in singula serie gemina longitudinali pertusa.

AREOLÆ 5 *latiores*, ad latera magis longitudinaliter muricatæ, in medio læviores.

AREOLÆ 5 *angustiores* latioribus dimidio tantum angustiores et similiter muricatæ.

One of the MS Lectures has the word »triplicatis» explained thus: »divided into three parts», and as the final term of the diagnosis: »basi decemfissis», words answering to the »nec 10 fissuris notata» of the *E. esculentus*, but omitted in all the published diagnoses. The term »decussatim» is explained: »in quincuncem Plinii».

The specimen LINNÆUS had before him exists no more in the collection, and appears to have been lost before the time of SWARTZ, but the want of it is little felt since the general form, the geminous pores disposed in three longitudinal rows, and the ten deep linear fissures<sup>1)</sup> of the peristome, leave no

<sup>1)</sup> Folium fissum est divisum sinibus linearibus marginibusque rectis. Phil. Bot., ed. Holm., 1751, p. 43.

doubt about the genus, and the description enables us to designate very nearly the modern species it means. The characters taken from the zonæ and the peristome are both present in *Boletia* and *Tripneustes*; and in no other genus. But LINNÆUS never could have applied the terms: »hemisphærica sed magis gibba» to a *Boletia*, nor would he have overlooked its concavated basis. In that genus also the pores are not very clearly »triplicate». To *Tripneustes* AG. therefore we are led, to that group within the great genus *Echinus* which was distinguished already by BLAINVILLE as his section *G*<sup>1)</sup>, and after him by DESMOULINS as section *F*<sup>2)</sup>. This last-named author alone has »*E. Gratilla* L.?» as a doubtful synonym under the *E. fasciatus* LAMARCK. This species, however, which DESMOULINS besides indicates as unknown to him, is characterised by LAMARCK<sup>3)</sup>: »fasciis quinqueporis indivisis» and consequently must be here discarded. Of the remaining species of *Tripneustes*, the West Indian *T. esculentus* LESKE does not answer to the Linnean description; its general form is not »hemisphærica, gibba», the disks of the area are mostly not as conspicuously »laviores» as in other species. Neither can the median pedicellar pores be said to answer to the words of the description; that each zone consists of three series of pores, each series being a longitudinal row of geminous perforations, because, in *T. esculentus* the inner row alone is regular, the outer one nearly so, but the middle one very irregular. It is among the species described inhabiting the Indian Ocean and the Pacific, that one in particular fully answers to the Linnean description, the species common at Mauritius, Zanzibar, Keeling Island etc., which BLAINVILLE in 1825 named *Echinus inflatus*.

If after the example of ALEXANDER AGASSIZ, who unites them all into one species called *Hipponoe variegata* LESKE, the forms inhabiting the seas of the old world, distinguished by LAMARCK and doubtfully admitted by BLAINVILLE and LOUIS AGASSIZ, are regarded as only nominal, the synonymy becomes chiefly as follows:

<sup>1)</sup> Dict. sc. nat. XXXVII, p. 91.

<sup>2)</sup> Etudes, p. 288.

<sup>3)</sup> Hist. An. s. Vert., III, p. 45.

### Tripneustes Gratilla L.

*Cidaris miliaris* species III, *Angulosa*, KLEIN, Disp. p. 18, t. II, fig. *F*, orig., 1734. — *Cidaris assulata*, species IV, *variegata*, ID., ib., p. 21, t. X, fig. *B, C*, orig., 1734.

1758. *Echinus Gratilla* L. S. N. ed. 10, p. 664.  
     »          »          » 1764. M. L. U. p. 707.  
                                   1767. S. N. ed. 12, p. 1102.
1778. *Cidaris angulosa* LESKE, Addit. p. 92, t. II, fig. *F*.  
*Tripneustes* »          » 1879. JEFFREY BELL, Proc. Zool. Soc.,  
                                   p. 655.
1816. *Echinus virgatus* LAMCK, An. s. Vert. III, p. 44.  
 1816. » *pentagonus* LAMCK, ib. III, p. 46.  
 1816. » *subcæruleus* LAMCK, ib. III, p. 49.  
 1825. » *inflatus* BLAINV. Dict. Sc. nat. XXXVII, p. 91.  
     »          »          » 1834. Man. d'Actinol. »Oursin enflé»,  
                                   Atlas, pl. XX, fig. 4.

The »*Cidaris assulata variegata*» of KLEIN is to all appearance the *Tripneustes subcæruleus* LAMCK. LESKE<sup>1)</sup> makes its pre-Linnean appellation binary: *Cidaris variegata*, but, unacquainted as he was with its type specimens, describes under that name and as a smaller specimen of the species, an *Echinus* from the collection of the PRINCE of SCHWARZBURG-RUDOLSTADT, evidently of another genus. Its phrase: »tria pororum paria, obliquis adscendentibus transversis ordinibus posita, . . . os levissime sinuosum» has been assumed as being meant for the *Lytechinus variegatus* LAMCK, and consequently the name: *variegata* LESKE must be withdrawn from the species figured by KLEIN.

The name of *Echinus sardicus* LAMCK has very generally been used to designate a form of *Tripneustes*. Already, however, in his monograph of 1825 BLAINVILLE<sup>2)</sup>, who had before him specimens of the Paris Museum »with the name given by LAMARCK», altered it to »*inflatus*», and rightly, because LESKE had used »*sardicus*» for a widely different species.

Three forms were placed by LAMARCK in close connexion: 8. *Echinus melo*, 9. *E. sardicus*, both inhabitants of the Medi-

<sup>1)</sup> Addit. p. 149.

<sup>2)</sup> Dict. Sc. Nat. XXXVII, p. 91.

terranean, and 10. *E. acutus*, habitat then unknown. For the *E. melo* he refers to GUALTIERI, t. 107, fig. *E*, 1742, but it is more accurately figured by GINANNI<sup>1)</sup>, as »Riccio marino detto da' nostri Marinari Pescatori Melo marino». LAMARCK says it has been confounded with the *E. sardicus* which he, consequently, regards as the principal form and as a species of long standing. The *E. acutus* is distinguished from both. The trivial name: *sardicus*, that is: from the sea of Sardinia, comes from the »*Echinometra maxima Pelagica Sardica*» of ALDROVANDI<sup>2)</sup>, the figure of which represents something between the *E. melo* and the *E. acutus*. Accordingly DESMOULINS<sup>3)</sup> felt inclined to give the name of »*sardica*» to a species of the Mediterranean, the *E. pseudo-melo* BLV. and in 1841 AGASSIZ<sup>4)</sup> declared the *E. sardicus* LAMCK, »a synonym of the *E. pseudomelo* BLV.», to come very near to the *E. melo*, »from which it differs in the smallness of its pores rather than in its general form». But some years afterwards<sup>5)</sup> he placed the *E. sardicus* LAMCK at the head of his genus *Tripneustes*, attaching, as it seems, a greater weight to tradition than to the description LAMARCK himself has given. LAMARCK<sup>6)</sup> quotes KLEIN, LESKE and SCILLA. KLEIN<sup>6)</sup> seems to have adopted the species had in view by ALDROVANDI as the »*Cidaris assulata ALDROVANDI*», but substituted a new figure not nearly as good as that given by its author. LESKE<sup>7)</sup> attached to that Kleinian figure the name *Cidaris sardica*, but accompanied it with a description of his own, taken from specimens in the collections of LINCK and TRIER, manifestly of still another and different species, as becomes obvious from its being said to have ten to twelve rows of tubercles in the interradia, four or six in the ambulacra, and the pores arranged into arcs of five pairs. The species thus described cannot have been a *Tripneustes*; it probably rests on the *Spærechinus granularis* LAMCK confounded with the *Strongylocentrus lividus* LAMCK, and until it be properly found out, the name *sardicus* LESKE must be *in suspensio*. Consequently the reference to LESKE is to be withdrawn, and

1) Opere postume, II, p. 38, t. 28 et 29, fig. 173; 1755.

2) De animalibus exsanguibus, p. 411; 1642.

3) Etudes, p. 285; 1837.

4) Monogr. d'Echinod., IV, Preface, p. III.

5) C. R. p. 59; 1847.

6) Disp., p. 21, t. IX, fig. *A*, *B*.

7) Addit. p. 146.

along with it that to SCILLA<sup>1)</sup>, who gives a far too indefinite figure of some fossil form. If now, after this, the description given by LAMARCK is duly considered, it cannot be overlooked that, while with regard to every species really belonging to Tripneustes AG., namely the *E. ventricosus*, *E. virgatus*, *E. pentagonus*, he concerning the zonæ poriferæ uses the term: »fasciis triplicibus divisis», and of one alone, the *E. subcæruleus*, the term »subtriplicibus», he says with regard to the *E. sardicus*: »fasciis porosis rectis, pororum paribus transverse ternis», which may as readily be understood in accordance with the disposition of the pores in Echinus proper: in transversely ascending rows of three pairs. If this interpretation is accepted, it follows that LAMARCK must be acquitted of having attached the appellation: Sardinian to an inhabitant of tropical seas; that his *E. sardicus* is not a Tripneustes; and that AGASSIZ was right in his first statement, that the Lamarckian species: *Echinus sardicus*, *E. melo* and *E. acutus* were all three described from specimens from the Mediterranean, and that they belong to the group of Echini, which besides these comprises the *E. elegans* and *E. norvegicus* of DÜBEN et KOREN, the *E. rarispinus* and *E. depressus* of G. O. SARS, the *E. gracilis* of AL. AGASSIZ, the *E. microstomus* of WYV. THOMSON, all distributed in the North Atlantic and the Mediterranean, and excessively difficult to distinguish by stable characters.

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<sup>1)</sup> Corp. mar. p. 58, t. 13, fig. 1.



## 15. ECHINUS LIXULA L.

Tab. 3.

ECHINUS hemisphæricus, ambulacris denis, paribus approximatis, areis transversim punctatis, muricatis.

S. N. ed. 10 et 12.

*Habitat in Oceano Indico.*

TESTA hemisphærica, basi planiuscula.

AMBULACRA 5<sup>æ</sup> parium: paribus approximatis; areola intermedia lineari acuta.AREÆ 5 *maiores* punctis eminentibus: seriebus transversis sæpe 6 ad 7 utrinque, ubi plurimæ; superiores sensim pauciores.AREÆ 5 *angustiores* duplici serie punctorum eminentium.

In the diagnosis the Lectures, 1752, and S. N. ed. 10, 1758, ed. 12, 1767, have »punctatis», the M. L. U., 1764: »punctis».

Tradition has from time to time pointed to some species of *Arbacia* GRAY as designed by this Linnean name. FAHLBERG in his Contributions to the Natural History of St Barthelémy<sup>1)</sup>, of 1786, enumerates among its marine productions: »E. Lixula», meaning no doubt the *Arbacia punctulata* LAMCK., of which there are specimens still extant in our State Museum probably sent home by him in 1791. In 1825 BLAINVILLE<sup>2)</sup> expressed his conviction that the »E. lixula L. (Mus. Lud. Ulr. 707)» might coincide with his *E. æquituberculatus*, and DES-

<sup>1)</sup> Kongl. Vetenskaps-Akademiens Handlingar, 1786, p. 254.

<sup>2)</sup> Dict. d. Sc. Naturelles, XXXVII, p. 77.

MOULINS<sup>1)</sup> was inclined to the same opinion, adopted also by AL. AGASSIZ<sup>2)</sup>.

The word »sape» of the description indicates that LINNÆUS had before him several specimens, and there are in the Drottningholm collection five of a species of *Arbacia*, all denuded. I shall call them *a*, *b*, *c*, *d*, *e*. They occupy four boxes. Of these two, containing *a* and *e*, are marked with the usual »Mus. Gust. Ad.» in THUNBERGS hand, and *a* is provided with a printed label: *Echinus Lixula*. The two other boxes, one for *b*, another for *c* and *d*, have each the Swartzian label alone. The authenticity of these specimens is thus fully established. They answer completely to the Linnean description of his *E. Lixula*, and are without doubt its prototypes. The specimen *e* is not in a sufficiently good state for being taken into account, and has been omitted.

Two species, dispersed under Nos 18 and 24 among the Echini of LAMARCK<sup>3)</sup> were recognised by BLAINVILLE<sup>4)</sup> as forming, together with some others known to him, a natural group, the division *A* of his highly meritorious monograph. Ten years later it had a generical name given it by GRAY<sup>5)</sup>: *Arbacia*, and a few months after another by DESMOULINS<sup>6)</sup>: *Echinocidaris*. Its limits all the time remained the same until lately DUNCAN and SLADEN<sup>7)</sup> on good grounds removed the well-known *Echinus niger* of MOLINA, which is to be the type of a genus of its own, bearing the name *Echinocidaris*, all but coeval with *Arbacia*, and under which it was placed as the leading species by DESMOULINS<sup>8)</sup>, though under the wrong appellation of *E. pustulosa*. The *Agarites* and *Tetrapyga* of AGASSIZ<sup>9)</sup>, the *Pygomma* of TROSCHEL<sup>10)</sup>, are posterior.

Thus limited the genus *Arbacia* presents the following characters, such namely as are generally used in comparing and determining denuded specimens.

1) *Etudes*, p. 307.

2) *Revision*, p. 92.

3) *An. s. vert.*, III, p. 47, 49; 1816.

4) *Dict. Sc. Nat.*, XXXVII, p. 75; 1825.

5) *Proc. Zool. Soc.*, III, p. 57; 1835, April 28. — Reprinted: *Phil. Mag.*, VII, Number XL, October 1835, p. 329.

6) *Etudes s. l. Echinides*, p. 34. *Actes Soc. Lin. Bordeaux*, VII, 4; 1835, August 15.

7) *Journ. Lin. Soc.*, Zool., XIX, p. 53.

8) *l. c.* p. 304, *Actes*, IX. 1837; XXVII, pl. 11, fig. 7, 8.

9) *Monogr. d'Echinod.*, II, *Scutelles*, *Introd.* p. 7; 1841.

10) *Archiv f. Naturg.*, XXXVIII, p. 293, 1872; XXXIX, p. 308; 1873.

The test is orbicular, rarely slightly pentangular, from the ambulacra being faintly prominent. Vertically it never is globose, generally hemispherical or slightly flattened, the height varying in adult or nearly adult specimens of the different species between 0,63 and 0,45 of the diameter. The young are more flattened. The basis is flattened, in some species moderately so, with the lateral flexure rounded. In the former case the interradia are dorsally more or less convex, in the latter they are slightly sunk in the middle. At the ambitus the breadth of the ambulacra is to that of the interradia as between 30 and 46,6 to 100, the lower percentage being found in the species with a flattened underside.

The stoma is large, proportionally wider in young specimens, pentagonal, the ambulacra bilobate, forming its sides; the interradia emarginate, making its angles. There are no incisions for the peristomal gills, but these are supported, on each interradium, on two tongue-shaped lamellæ, exerted from the interior, laid back, inside out, and cemented to the test so as to conceal the marginal portions of the first plates with a part of their tubercles; in the middle they join into a more or less projecting nib. The niche for the single spherid is placed close over the middle sinus of the ambulacrum.

The Arbaciæ are orthoproctic and the retrograde tendency of the periproct very little modifies the calycinal system. In the youngest specimens all the radials are at equal distance from it, and in full-grown specimens the I, V and IV alone are perceptibly approached. Consequently the periproct is irregularly oval, its longest diameter extending from a point a little in front of the suture of the costals 3 and 4 to the costal 1, rather behind its middle line. The closing valves are normally and almost invariably four, two on each side of the longer diameter; anomalously there may be three only or one or two of them may be divided, or in part broken up into small pieces, as in the anal membrane of most other Echinids. The radials present the occurrence, elsewhere rare, of double orbits (*s. v. v.*) placed adorally and separated by a process<sup>1)</sup>. The whole calycinal system is not very large, generally low and even, but covered with the same superficial layer that forms the exterior of the disks and other parts of the upper side.

<sup>1)</sup> Etudes, s. I. Echinoïdées, p. 66, f. 7, and p. 67, fig. 1—5.

Like the other Arbaciadæ this genus is heteropodous, the dorsal pedicels being, presumably, branchial, the ventral locomotive. Accordingly the difference in shape is conspicuous between the dorsal and the ventral peripodia. From the radial of the calycinal system to the ambitus each zone of pores is simple, narrow, slightly undulating, a single series of transverse, depressed peripodia, with large perforations and the separating bridge narrow and low. Close under the ambitus all this is changed. The peripodia decrease in breadth and become more oval, at last nearly circular, the bridge swells and encroaches upon the perforations, the margin is flattened, and the locomotive form soon comes out, with the diagonal gradually directed adorally, while the simple arrangement is exchanged for rows of three, at first nearly longitudinal, then gradually approaching to the transverse, thus causing the zone to expand largely. Round the peristome the peripodia are disposed conformably to the general rule<sup>1)</sup>, thus: 2, 3, 3 in the series I a . . . Vb, 2, 2, 3 in the series Ib . . . Va.

The spine-bearing tubercles present the remarkable character of being all primary, none secondary.

On the ambulacra they alternate in two vertical approximate series bordering on each side upon the zone of pores. TROSCHEL drew attention to a marked difference in their disposition. Below, and visible from the second or third plate from the peristome, the two series are in all the species contiguous, and in some instances, as in the well-known *A. æquituberculata* BLV., continue so all along, while in others they separate a little near the ambitus, and thus, as in the *A. lixula* L., leave between them a narrow areola pointed below and above. It is however only in full-grown or nearly full-grown specimens that this character is fully developed and made more apparent; young specimens have the two ambulacral series more closely approximated. In the upper part of the ambulacra the two series become, in all the species, more or less deranged from the unequal development of the tubercles and their more or less sudden diminution or even partial deficiency, so as to end apparently with a single series.

On the interradia the tubercles are disposed vertically on each half in from three to six series, and transversely in re-

<sup>1)</sup> Etudes s. l. Echinoïdées, p. 25, 26, t. XVIII, f. 156.

gular rows parallel to the long axis of the plate, which below are directed obliquely upwards so as reciprocally to converge angularly towards the middle suture, until nearer the top they gradually assume an almost parallel direction. Of the vertical series the marginal ones on each side are primordial, normally regular and continuous all through, very rarely interrupted, and nearly convergent superiorly. Their tubercles are not always the largest. They are followed inwards by other successive primary vertical series, in adult specimens from two to five, gradually abbreviated below and above. This disposition is attained during growth and by slow and unequal degrees, the process of the formation of spines and tubercles being here, as in Echinoids generally, not a concomitant of that of the plates, but independent of it. In a young specimen of 5 mm., of the well-known *A. æquituberculata* which is to have on either side six vertical series, there are only two series. Of these the first on either side consists of seven tubercles of which the uppermost is very small, and the last-formed plate is still without any. The second vertical series has its uppermost very minute tubercle as far back as on the fourth plate from the top. Thus it comes that, owing to the retarded appearance of the tubercles forming the succeeding series, the disks of the interradia in not fullgrown specimens are more or less bare and present an indication of a »star», as BLAINVILLE called it. In the species of the Atlantic Ocean, and in one alone of the West American, this star disappears entirely on the adult; within the other group, of species chiefly from the Pacific side, it is otherwise. In the *Arbacia alternans*, *Dufresnei*, *spathuligera*, *stellata*, *punctulata*, the formation of successive tubercles on the disks is not merely retarded, but nearly altogether arrested, and accordingly the star becomes in the adult strikingly manifest.

As a rule each additional vertical series of tubercles makes its appearance near the middle suture of the interradium. The plate lengthens transversely and a new tubercle is formed on its inner part. As in all the Echinids the spines and their tubercles begin to form on those plates which during growth become peristomal, and proceed upwards, growing successively more slowly above the ambitus. At the ambitus, where the test is widening at the greatest rate, the latest tubercles become comprised within a small, more or less distinct, lanceolate

space, closed above and below by older converging series. A remarkable exception from this mode of increase sometimes occurs in virtue of which a new adventitious vertical series of tubercles is added, not on the disk, near the middle suture, but at the margins, externally, along a line closely bordering upon the zone of the ambulacrum. TROSCHEL was the first to observe this in the authentic specimen of old KLEIN'S *Cidaris assulata pustulosa*  $\beta$ , that lay before him as now before me, and it is readily seen also, and more developed, in the largest of the Linnean specimens of *A. lixula* L., *Tab. 7, fig. 1*, and, in a beginning state, in a specimen of *A. Dufresnei* BLV. Outside the first, primordial, series, between it and the suture, an adventitious vertical series is forming, not proceeding from the base and continuing upwards, but at the middle part of the height, where there is more room, somewhere from the sixth plate, or so, to the twelfth or fourteenth, or thereabout, and not going on continuously, with a tubercle on every plate, but interruptedly, as shown by the following tables.

Cidaris assulata pustulosa $\beta$ KLEIN.					Arbacia Lixula L.					Arbacia Dufresnei BLV.				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
a b	a b	a b	a b	a b	a b	a b	a b	a b	a b	a b	a b	a b	a b	a b
—	—	—	—	—	—	14	—	—	—	—	—	—	—	—
—	—	12	—	—	—	—	12	12	—	—	—	—	—	—
11	11	—	—	—	—	—	—	11	—	—	—	—	—	—
—	10	—	—	—	10	10	—	—	10	—	—	—	—	—
—	—	—	—	—	9	9	9	—	9	—	—	9	—	—
—	—	—	8	—	8	8	8	8	8	—	8	—	8	8
—	—	—	—	—	7	7	—	—	7	—	—	—	—	—
—	—	—	—	—	6	6	6	—	6	—	—	—	—	—

It is seen that the plates 8 to 12 bear the greater number of these tubercles. They are always smaller on the upper plates, and each of them appears at first above the primordial tubercle upon a marginal expansion of the plate, and then slides down into its proper place in the transverse row and there attains the normal size. They are seen nowhere in the young and are few and minute in the half-grown animal, while in nearly adult specimens they have increased in size and number and gradually are filling the vacant places. At last, it may therefore be supposed, in old specimens a complete series of these »wisdom»-tubercles will have been brought about

by means of a new *modus operandi* of the formative activity.

In this genus the formation of spine-bearing tubercles, its gradual progress from below upwards, its retarded appearance or even failing on the disks, is to a great extent dependent upon another of the skeletal elements early attaining a degree of development rarely seen among the Echinoids.

When the soft tissues are removed from the test of an adult *Arbacia* there comes into view, on the calycinal system, on the interradia as well as on the ambulacra, their areolas and zones of pores, a growth superposed to the proper surface of the plates, luxuriant in some, evanescent in a few species, of calcified protuberances not serving as supports to organs of any kind, *Tab. 7, fig. 1—4; Tab. 8, fig. 4—8*. Though by no means peculiar to this genus, being in fact of extensive, presumably universal occurrence among Echinids, it is developed in the *Arbaciæ* in a remarkable manner and affords specific characters of no little value. It is not unlikely that LINNÆUS designed it by the word »punctatis» of the diagnosis. It has commonly been comprehended under the general name of »granulation», »granules», »miliaries», terms including at the same time true spine-bearing tubercles, secondary and tertiary, as well as those of the pedicellariæ and the spherids. It constitutes, however, a system by itself, highly dissimilar and even antagonistic to that of the tubercles, and it will therefore be convenient, at present and in order to keep it distinct, to designate it by a proper name, for which I propose that of *epistroma*. In the adult *Arbacia* it generally appears under two distinct forms: partly as a continuous finely striated layer, compact or nearly so, in which are imbedded radiating rows of very minute glossy knobs, and partly as assemblages of larger, separate but crowded, sessile or sub-pedunculated protuberances; *Tab. 7, fig. 1—4*. Wherever the test is devoid of spine-bearing tubercles, the former structure prevails, as on the calycinal system and on the disks of some species, *fig. 3, 4*; the latter makes its appearance in the vicinity of tubercles, that is in the ambulacral areola and on the greater portion or on the sides of each interradium, *fig. 1*, and on the zones, *Tab. 8, fig. 5*. Consequently, when the epistroma is followed from below upwards, it is seen that on the basis of the test, where the tubercles are closely crowded, it is much less developed than

on the upper side, and consists of simply globular knobs sparingly clustered in the narrow interstices. At the ambitus these knobs increase in number and size, encircle the bases of the tubercles and attain their highest development: on the ambulacra near the middle suture and on the interradia outside the primordial tubercles, but diminish on the inward portion of the disk, and while there the formation of tubercles is arrested, they are bedded more or less suddenly in a continuous, compact layer or crust, even or slightly swelling, containing the protuberances reduced into minute glossy knobs, nearly sunk and disposed in linear but slight rugosities divaricating towards the sutures and more or less distinctly corresponding from plate to plate, *Tab. 7, fig. 3, 4.*

Such is in its general features the epistroma of the adult *Arbacia*. With a view to make it somewhat better understood, and though at the peril of wandering widely from my proper subject, I shall venture here to subjoin some observations on the earlier phases of its appearance. On *Tab. 8* a magnified representation is given, in *fig. 1* of the calycinal system and parts of the ambulacrum III and the interradium 3, and in *fig. 2* of a portion of the ambulacrum I, both taken from the test of a young specimen of the *Arbacia æquituberculata* BLV., 5 mm. in diameter, from which the soft teguments had been carefully removed.

As far as it may be allowable to conclude from observations on one or two species, it seems that the epistroma, originally to all appearance a modification of the membranous envelope of the pluteus, is a thin cuticular layer external to the matrix layer of the spine-bearing tubercles, and to the underlying skeletal plates, distinct from both and distending as they grow. It calcifies after its own manner, along certain regular lines forming together a system of ridges which tend to unite into a network of triangular meshes having its centre within the calyx and radiating from there over ambulacra and interradia. At that early stage, when the Echinid has used up the nutriment derived from the pluteal state and, with the alimentary canal opened and functioning, has begun to feed, the growth of the perisome of the young *Arbacia* by means of new plates added at the aboral margins of those already formed, ambulacral and interradiial, is so rapid, and the rate of formation of spines and tubercles relatively so slow,



that when the animal has attained a diameter of 5 mm., *Tab. 9, fig. 5*, a succession of plates devoid of tubercles, has built up the dorsal portion of the flattened test, and expanded it to such a degree that the oldest plates, the bearers of the first spines and tubercles, have nearly all been made to move over upon its ventral side, under the equator. There the tubercles, already large and crowding, leave little room for the epistroma to develop, while this at the same time has for itself alone the whole of the dorsal side.

The periproct, *Tab. 8, fig. 1*, presents a sub-oval, rounded outline and is already slightly drawn backward into the costals 1 and 5. Its long diameter, to which the short one is at right angles, lies, exactly as in the fullgrown animal, between a point a very little in front of the suture between the costals 3 and 4, and another, opposite, a little behind the middle of the costal 1. It is already provided with the normal four closing valves. There is no indication of sexual pores. The costal 2, somewhat larger than any of the other four, is penetrated by a few madreporic pores.

The periproct is circumscribed by a very conspicuous and regular pentagon, formed by the epistroma, *fig. 1*, of five straight linear sides that cross the sutures between the costals, while its angles, entering upon these, come to be placed on their middle line, at some distance from the periproctal margin. This pentagon, accordingly, is heterotropical to the primitive pentagonal central ossicle of the calyx, already converted, in consequence of the eruption of the excretory opening, into the secondary structure of the rounded proctal apparatus. Inside the pentagon, on that inner portion of each costal which has been modified in connexion with this remodelling, the short and steep slope towards the periproctal margin is no more what it was at an earlier age, but paved, like the valves, with crowded, minute, lengthened nodules, in rows directed downward. Each side of this inner pentagon is a ridge formed by the rising of the epistroma, and consists of a seemingly cellulose tissue supporting a nearly regular row of glossy transparent globules. Each of its angles closely approximates the base of a high protuberance, a sub-pedunculated, conical, berry-like, regular compaction of numerous minute oval globules, *fig. 3*. From the base of this protuberance there extend, on each side, other ridges, smooth and

straight, one of which, nearly parallel to the side of the pentagon, passes over the suture, continues into the adjacent costal, and thus forms a side of an outer pentagon. Three or more ridges are carried diagonally across the sutures into the adjoining radial and directed towards a triangle formed by three somewhat smaller berry-like protuberances, the uppermost one or two converging with the corresponding ones of the contiguous costal and tending to merge into the base of the middle protuberance, while the rest are directed towards another of the two lateral ones that stand above the »orbital» notches. Over the projecting mesial septum the epistroma descends on the ambulacrum. There it forms, at each margin of the narrow areola, and bordering upon the zone of pores, a glossy ridge, which is seen to rise, on each of the plates still devoid of tubercles, into an erect protuberance. On the interradia it is the same; the ridges connect and rise into protuberances at the knots, on each half a first and lateral series, and a second less numerous. The ridges are still in this early stage continuous and cross without the sign of a break the underlying sutures which are seen through their transparent substance, — in a few places only they are interrupted or contract a little as if preparing to part. In this state the epistroma extends over nearly the entire dorsal region. Four or five protuberances in a series may be counted in the ambulacra, three in the first ambulacral series, alternating on each side, when the two lowest at the ambitus are approached each by a spine and tubercle rising from under the thin envelope, the newest of the series as their formation advances from the ventral side, and at this stage has as yet hardly transgressed the equator, *Tab. 8, fig. 2, Tab. 9, f. 5*. It soon passes this limit. When the two antagonistic structures meet: the reddish vitreous epistroma extending from above, and from below, successively forming, the highly contrasting tubercles, ultimately to become the stronger of the two, each raising its opaque-white mamelon, to meet the nascent spine, then the cone, and lastly making room for its scrobicular circle expanding above, the epistrome is seen at first to hold its own, as it were, its glomerated protuberances facing the tubercles, but soon gives way, until of its projecting components very little is seen among the large tubercles. The *Tab. 9, figs 1—4*, taken from another young specimen of *A. æquituberculata* are made to represent the

ridges, multiplying and radiating from the still erect protuberances, and now broken off over the sutures and beginning to be cut up, by contractions, into nodules, while the protuberances are approached by the rising tubercles, lowered and caused to droop, soon to be absorbed. In a specimen 9,5 mm. in diameter, still devoid of sexual pores, this juvenile aspect is farther altered. On the calyx the pentagon is hardly discernible, the costals have lost their protuberances, the ridges, still more increased in numbers have taken the form of beads, numerous contractions cutting them into very minute oval nodules. The radials still have their three protuberances, though somewhat reduced, or at least the middle one. On the uppermost plates of the ambulacra the epistroma keeps up its early form, two or three of its first protuberances standing upright, but on the third plate the tubercular mamelons appear, pushing up the thin envelope. On the interradia the formation of primordial tubercles has already reached the second plate from the top, and is fast reducing the lateral protuberances, one or two of which only are left on the uppermost plates, while on the disks they are seen on four plates, but low and subsiding, preparing to melt into other forms, and around their bases the ridges, numerous and bead-like, assemble into a swelling layer. Lower down, on the fourth or fifth plate from the top, the tubercles of the second series produce their mamelons, and upon their cones the glomeration of the dwindling protuberance spreads, yielding and dissolving; and ultimately leaves a trace only of its early presence, a reddish film on their aboral half.

When these juvenile features and the corresponding parts in a fullgrown specimen of the *Arbacia aquituberculata*, *Tab. 8, fig. 4*, are compared together, the periproct and the anal valves are seen to be much the same, but otherwise the dissimilitude is very great. In the adult the costals and radials are greatly changed. The same process that once had been at work in remodelling the dorso-central ossicle has extended to them, the protuberances have long disappeared, and the ridges, greatly increased in number, divaricating as from the first, by a process indicated already in the early stage and gradually becoming more powerful, are cut up into vastly multiplied crowded nodules. On the interradia it is the same; the berry-like bodies and connecting ridges, of which no trace

is left, are replaced by the growth of other forms, large and separate near the tubercles, minute and densely packed on the disk, *Tab. 7, fig. 1, 3, 4.*

The *Tab. 9, fig. 7* represents the juvenile appearance of these parts in an *Arbacia stellata* BLAINY., 6 mm. in diameter. The dull colour of the plates and the tubercular system sets off the bright red of the epistroma. The sexual pores are still missing, but the radiating ridges of the costals are largely multiplied, densely packed, discontinued over the sutures, and preparing to break up into minute nodules. On the ambulacra the glossy ridges are still intact and on each of them five or six of the berry-like protuberances stand upright, the lowest of them approached by the uppermost tubercles in the act of rising. In the interradia the alteration is more advanced, the rival structures meet much sooner, already on the third and fourth plate from the top. The strong glossy ridges are effaced, remoulded and converted into numerous dense rows of minute nodules, most conspicuous and brightly coloured where the protuberances have stood, near the middle suture. On the upper three or four plates the protuberances are still left, but reduced, and lower down, where they are neared more and more by the advance of nascent tubercles, they sink down, diminish and dissolve, until their only remains are little masses of minute nodules of a bright red colour sticking to the cone upon its aboral side, *Tab. 9, fig. 8*, or even nothing but a reddish tint left on a part of the thin film of the cuticula.

Another specimen, a little larger, 7,5 mm. in diameter, is more changed, but still retains much of the epistroma in its early form. On the costals, now provided with sexual pores, it is already reduced and transformed into a thin, compact, bright-red layer of divaricatingly radiating very minute nodules. The radials still bear their three protuberances, and from the projecting mesial septum the two ridges descend on the sides of the ambulacral areola, presenting at regular intervals a series of strong protuberances, up to eight in a row, until, a little above the equator, the tubercles are encountered. In the interradia this comes in the third plate from the calyx, and everywhere the epistromal glomeration is seen to lose form and to spread upon the cone of the rising tubercle. Further on, as the animal grows, the epistroma gra-

dually yields, its protuberances disappear almost entirely and their former presence is betrayed solely by the red tints near the tubercles and on the aboral half of the mighty cones. On the ambulacra it holds its ground better, and its protuberances, though much reduced, still remain on the uppermost plates. It is from this their tenacious resistance that arises the disordered sequence of the upper ambulacral tubercles in most species of the Pacific Ocean type of the genus.

On the intimate structure of the epistroma I have but little to say. Whenever a spine or a pedicellaria is severed from a tubercle, its part of the cuticular envelope goes with it, and the base alone of the naked cone is found covered with what is left, *Tab. 8, fig. 7, 8; Tab. 9, fig. 7*. Of this thin, external, continuous covering the ridges and protuberances are calcified portions, overlying the matrix-layer of the tubercles, by the slow eruption of which they are subverted and caused to transform. On the secondary large nodular bodies of the adult an assemblage may be seen of delicate prickles, *Tab. 8, fig. 6*, the same perhaps that gives rise to the appearance of connecting fibres in the interstices between the ovate nodules of the protuberances, *fig. 3*. The intimate constitution of the calcified substance is different from that of the plates and of the tubercles. When seen by reflected light it presents widely extended, deviating systems of parallel exceedingly delicate lines which come into view successively at different depths under the surface, *Tab. 9, fig. 6*.

In the foregoing the epistroma has been described as it appears on the test itself of the Arbaciæ. It may be questioned whether there is not something akin to it to be seen on the spines. These, it is well known, present three forms. Superiorly they are, on the interradia and to a greater extent on the ambulacra; short and thick and slightly bent, then, towards the ambitus, they become aciculate, rather long, slender or of moderate strength, and below the ambitus they are all shorter and more or less flattened. These ventral spines, the first developed, are lined at the top with a thin glossy covering first described by DESMOULINS<sup>1)</sup>, abbreviated and smooth on the dorsal side, ventrally descending a little way, with ribs determined by the striation beneath, but more or less

<sup>1)</sup> *Etudes*, p. 35, 307; 1835—1837. — *Actes Soc. Linn. Bordeaux* XXVII, 1869.

thickened. This terminal crust is seen already in very young specimens having none but these ventral flattened spines. A close and careful study may decide whether it has any claim to some connexion with the epistroma of the test; the *Echinocidaris nigra* bears it on the obliquely truncated tops of the ventral spines. In the *Cœlopleuri*, however, all the spines, flat and striated on the white under-side, carinated and smooth on the coloured upper side, are sheathed with it all over from near the collar. Its consistence also seems to be different from that of the epistroma.

ALEXANDER AGASSIZ remarks of his *Podocidaris sculpta*<sup>1)</sup>, that it has the general facies of a young *Arbacia*, and this resemblance is by no means lessened by the aspect of its epistroma. The juvenile structure which in the *Arbaciæ* gives way, at an early stage, to the subsequent, antagonistic and ultimately prevailing formation of the spinigerous tubercles, is found highly developed in *Podocidaris* and persistent at a much more advanced age, if not, as it will really appear, in the adult. In a specimen which I owe to the kind liberality of its discoverer, holding 10 mm. in diameter, — one of 17 mm. is said to be a very large one, — the entire dorsal side above the equator, more than the half of the whole test, is held by the epistroma and the pedicellariæ alone, to the exclusion of the tubercles which are confined to the restricted basal surface, their powerful growth being abruptly discontinued, all around, close below the ambitus. In the calyx the broad but short costals present each three protuberances in a mesial row, from which extend ridges, a few directed diagonally towards the protuberances of the lengthened projecting radials. On the narrow ambulacra, in breadth 0,30 of the interradia, each of the two lateral epistromal ridges bears a dense series of up to fourteen high and slender protuberances, while the connecting ridges give rise to nodules and a few lower protuberances. The appearance of the interradia is very remarkable. Each of their halves, *a* and *b*, has five vertical series of protuberances, the first consisting of two only, near the ambitus; the second of four, from the ambitus upwards; the third and fourth each of seven to eight, reaching from the ambitus to the top; the fifth, sub-sutural, alternating, of two or three protuberances. The first, second and third series

<sup>1)</sup> Revision, p. 152, 269, 405, Pl. IV. — Blake Echinoidea, p. 22.

of the one half, *a*, are parallel, or very nearly so, to the corresponding series of the other half, *b*, while the two fourth series of both halves are but slightly converging upwards. Transversely the protuberances are disposed in rows slightly rising towards the suture, and alternating with those of the other half. The connecting ridges, vertical and transverse, form everywhere meshes, and on the knots as in the interstices are seen very numerous tubercles, large and flat with minute mamelons, bearing long and powerful pedicellariæ.

This tendency in the epistromal protuberances towards a vertically parallel disposition, strikingly at variance with the convergence of the series of spinigerous tubercles, is not entirely lost in *Cœlopleurus*, though less developed in the *C. Maillardi* MICH. In a specimen of *Cœlopleurus floridanus* AL. AG.<sup>1)</sup>, for which I am likewise indebted to its first describer, the bright red epistroma on each of the five costals rises into a high protuberance from which rows of low elongated granules are diagonally directed towards five other eminent protuberances, one on each radial. On the ambulacra the epistroma, pale and faintly pustulated, covers the upper part of the disk and the zonæ. On the sides of the interradia it is red, and along the middle of each half forms a straight brightly coloured vertical ridge, bordered outwardly by an impressed line, while on the middle of the disk, devoid of tubercles and contrasting by its whitish colouring, it is nearly smooth, only crossed obliquely by slightly elevated broad bands and narrow rows of minute nodules. The middle vertical area thus marked is but slightly contracting upwards, and less so in the young, as it will appear from AL. AGASSIZ' figures, the ridges on its flanks having, as it were, an early tendency to become parallel like the vertical rows of protuberances in *Podocidaris*. These broad vertical areas, slightly or not narrowing upwards, bordered on each side by a ridge of contiguous or detached nodules, often accompanied by an impressed line, are very conspicuous in the tertiary species described by COTTEAU<sup>2)</sup> and by DUNCAN and SLADEN<sup>3)</sup>.

<sup>1)</sup> Blake *Echinoidea*, p. 23, Pl. VII, VIII.

<sup>2)</sup> *Cœlopleurus Delbosi* DESOR, *Ann. Sc. Géol.* XV, 2, No 2, p. 4, t. 1, fig. 15-20. — *C. Tournoueri* COTTEAU, *Act. Soc. Lin. Bordeaux*, XXVII, p. 248, t. 12, fig. 1-5. — *C. Rousseli* COTTEAU, *Bull. Soc. Zool.*, XI, p. 712, t. 24, fig. 6-11. — *C. Arnandi* COTTEAU, *Ann. Sc. Géol.*, XV, sub *C. Delbosi*, *Ech. nouv.*, I, t. 14, fig. 6-10.

<sup>3)</sup> *C. eques* VAL., DUNCAN et SLADEN, *Foss. Echin. Sind.* IV, p. 251, t. 39, fig. 3-8. — *C. Pratti* D'ARCH., DUNC. et SLAD. *ib.* p. 254, t. 39, fig.

Like the *Cœlopleuri* the *Echinocidaris nigra* MOL., in addition to its primary spinigerous tubercles, has, on the interradia, from the ambitus upwards secondary minute tubercles forming on every interrarial plate an upper transverse irregular row, and bears, all over, exceedingly numerous pedicellarian tubercles. Thus the tubercular element is prevalent, and the epistroma very much reduced. On the narrow ambulacra, in breadth 0,30 of the interradia, its protuberances, subpedunculate and globulous, reddish and semi-transparent, are seen forthcoming singly or few in number in the rare interstices left by the crowded pedicellarian tubercles; it crosses the zones of pores, swelling into bosses, and on the upper corner of the adjoining interrarial plate forms a little group of tumid irregular protuberances, while all along the plate it is almost entirely excluded, until at the middle suture it again comes forth as another similar group of protuberances.

Such are, briefly stated, the appearances assumed by the epistroma in the recent Arbaciadæ. Near to these come among fossil forms the genera *Dictyopleurus* and *Arachniopleurus* of DUNCAN and SLADEN<sup>1)</sup>, approximating *Cœlopleurus*, with two marginal ridges on the ambulacra and two others, mesial, on the interradia, all connecting by means of transverse and diagonal ridges, bearing tubercles at the knots, and more or less distinctly noduled; the *Glypticus*<sup>2)</sup> of AGASSIZ, with the luxuriant epistroma in exclusive possession of the upper test, with large deformed bosses and vertical ridges, and the *Codiopsis*<sup>3)</sup> described by COTTEAU who figures its epistromal protuberances, both apparently allied to *Porocidaris*; and the *Coptechinus* COTTEAU<sup>4)</sup> and *Progonechinus* D. et SL.<sup>5)</sup>, reminding of *Arbacia*. Farther away from the Arbaciadæ a compact epistroma is seen in the *Temnopleuridæ*, in *Salmacis* and its allies, in *Temnopleurus*, *Temnechinus*, *Opechinus*, *Trigonocidaris*, extending widely in various forms over great parts of the test, with the

9—12. — C. *Forbesi* D'ARCH., DUNC. et SLAD. ib. V, p. 287, t. 46, fig. 1, 2, 4, 7, 9. Tert. Ech. Kachh and Kattywar, p. 53, t. 12, fig. 1. — C. *sindensis* DUNC. et SLAD. Foss. Ech. Sind, V, p. 298, t. 46, fig. 3, 5, 6, 8, 10; t. 47, fig. 1, 2.

<sup>1)</sup> Fossil Echinoderms of Sind, p. 38, Pl. IX, fig. 1—3, 4, 5; X, fig. 5—8. — Ib. p. 42, Pl. IX, fig. 6—8.

<sup>2)</sup> Pal. Franç., Jura, II, p. 574, Pl. 414—421.

<sup>3)</sup> Pal. Franç. Jura, II, p. 571, Pl. 413. — Crét., VII, p. 774, Pl. 1189—1192.

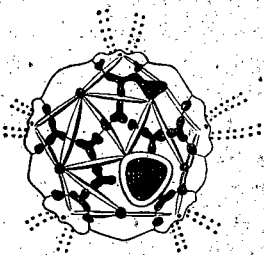
<sup>4)</sup> Bull. Soc. Zool. France, 1883, p. 456, Pl. 15, fig. 1—5.

<sup>5)</sup> Sind, p. 43, t. X, fig. 1—3.



characteristic trait of leaving open lacunæ, pits, grooves, »puncta semipertusa»<sup>1)</sup>. At a greater distance among the Regulares, it can be followed as a continuous expansion, the colouring element of the test, oftener compact, but not seldom composed of exceedingly minute, brilliant, nodules, as in the *Sphærechinus granularis* or the *Lytechinus variegatus*, or rising, as in the *Echinus esculentus* and the *E. miliaris*, into wart-like bosses. About all this, however, we are in the dark, being ignorant of the mode of development of the spines and pedicellariæ. And far away, among the Irregulares, structures are met with that may be other modifications of the epistroma, thus in *Pygaster*, in *Echinoneus*<sup>2)</sup>, in the *Clypeastridæ*, and further research will extend its occurrence still wider.

In recent *Saleniæ* the berry-like protuberances have been observed<sup>3)</sup>; the sexual pores seem to open from under their bases. In fossil forms the epistroma, generally luxuriant, covers the expanded calyx with its raised scutiform layer, rarely smooth and even, oftener marked at the margins of the ossicles with deep lacunæ penetrating to the proper surface of these, in some species mere points, »puncta semipertusa», in others large and roundish holes, or grooves, clefts and fissures, but always reducible to a typical model seen in certain species like the *Salenia trigonata* AG. The dorso-central ossicle — as in the whole family — is to a great extent preserved intact in the adult, a minor portion only having been eroded for the periproct; the greater part of which has been



The calyx of the *Salenia trigonata* AG. From COTTEAU.

taken from the costals 1 and 5. The epistromal pentagon, heterotropous to, but concentric with, the dorso-central ossicle, is readily recognised with the ridges it emits into the radials. But from each of its five angles another ridge, not present in the *Arbacia* because early lost,

<sup>1)</sup> See, on the structure of the test in the *Temnopleuridæ*, its pits and grooves, the researches of Professor DUNCAN in the *Linnean Society's Journal, Zoology, XVI, p. 343.*

<sup>2)</sup> Compare *Etudes s. l. Echinoïdées, Pl. IX, fig. 79, 80.*

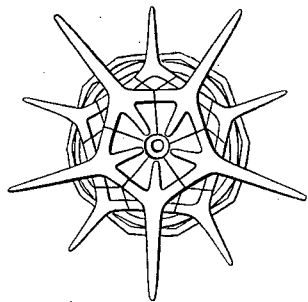
<sup>3)</sup> *Etudes, Pl. XIX, fig. 159, 161, 163.* — AL. AGASSIZ, *Blake Echinoidea, p. 20, pl. VI, fig. 17.*

departs aborally, and the five ridges thus formed converge over the middle point of the dorso-central ossicle.

If, with these features of the Salenian calyx in view, we recall in the Arbacia the idea of its once aprocitic calyx, such as it must have been before the remodelling outbreak of the efferent aperture, homology demands to see restored, with the central ossicle in its unimpaired pentagonal outline, also, converging at its middle point, the five ridges emitted from the angles of the heterotropous epistromal pentagon. The conformity then would become complete. And thus another instance would present itself of a structure, seen to exist but transiently during the early stage of a recent form, as the Arbacia, being found formerly to have been constant for life in other not distantly related but mostly extinct forms, as are the Saleniæ. And to these it seems to have descended from other forms again, of an ancestral type and infinitely more remote antiquity. The succession,

witnessed by Paleontology, of the »Echinus spinis mobilibus aculeatus» to the early Crinoideans, such as the Callicrinus, with its retiform epistroma rising into inter-sectional acuminate protuberances, recalling those in many Asteriads -- and, distantly, the rods of some Plutei, — is seen going on to-day under our eyes during the early individual development of the Arbacia.

If this be so, it may be allowable to surmise the existence of this striking skeletal feature in the Ophiuræ also, and perhaps even in the Holothurians. It was a wish to obtain some light regarding one of its appearances that drew me into this cursory digression. It is time to leave to others the task of testing the validity of its suggestions and of further prosecuting its object, and, for me, to revert to the Linnean species.



The Calyx of the Callicrinus Koninckianus ANG. From ANGELIN, Iconogr. Crinoideorum.

The ambitus of the largest among the specimens of *Arbacia Lixula* L., *a*, *Tab. 3, fig. 1, 2, 3*, is very slightly pentangular, that of the other three, *fig. 4, 5*, circular. Vertically the test is hemispherical, rounded, the height being in *a* 0,55,

in *b* 0,61, in *c* 0,53 in *d* 0,41; in *e* 0,54 of the diameter. The basis is slightly flattened, like that of *A. australis* TROSCHEL, and somewhat tumid at the interradia; in the young specimens *c* and *d* it is rather flatter. The stoma is normal, in *a* its antero-posterior diameter 0,57 equals that of the test. The lamellar supports of the gills are rather short, the mesial nib prominent.

The calycinal system presents nothing particular; the sexual pores of the adult are oval.

The transverse breadth, at the ambitus, of an ambulacrum is 0,30 of that of the next interradium, which agrees with their mean relation in the Atlantic group.

A striking feature in the *Arbacia Lixula* L. is the smallness of the spine-bearing tubercles. In *a* the diameter of their scrobicular circle hardly exceeds two millimeters, while in the *A. australis* TROSCH. and *A. æquituberculata* BLV. it attains 2,5 mm., in the *A. punctulata* LAMCK. even 3,2 mm. A peripheral inter-radial plate measuring 12 mm. bears seven or even eight tubercles, while in an *A. æquituberculata* of the same size the corresponding plate of 12 mm. has five or six. Their vertical series are disposed in the following manner. In the interradia of *a*, in which I count 17 coronal plates, in *b* of 16, and in *c* and *d*, of 15 and 14, their peristomal beginnings being, as in all the species, concealed beneath the gill-supports, they are arranged in the interradium 5 as seen in the following tables, showing the lowest plate on which each series begins, and the uppermost where it ends, always counting from the calycinal system:

Spec. *a*, diam. 45 mm., plates 17.

Series	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
1 begins		ends	1	1
2			3	2
3			5	4
4	15	15	6	6
5	14	14	8	7
6	13	13	9	9
7	12	11	11	10

Spec. *b*, diam. 40 mm., plates 16.

Series	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
1 begins		ends	1	1
2			4	3
3			5	4
4	14	13	6	6
5	13	13	8	7

Spec. *c*, diam. 32 mm., plates 15.

Series	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
1 begins		ends	1	1
2			3	3
3	13	13	5	5
4	12	12	7	7

Spec. *d*, diam. 27 mm., plates 14.

Series	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
1 begins		ends	1	1
2			3	2
3			5	4
4	11	10	6	6
5		10		8

The series are seen to follow each other regularly, the later of them being only very slightly retarded. The faint indication of a star in the non-adult specimens comes from the temporary smallness of the tubercles of the fifth and sixth series. It disappears entirely in the adult. The mesial lanceolate space is distinct; it contains the few minute tubercles of the seventh series, *Tab. 3, fig. 3.*

The ambulacral tubercles are somewhat smaller than the corresponding interradiial ones. Above the ambitus they separate so as to leave between their scrobicular circles a distance equalling the half part of one circle. Ventrally the first four pairs are rather close together, while upwards, above the ambitus, the tubercles of either series become more and more sparse, till near the top one of the two series alone continues or surpasses the other in the size of its tubercles.

The epistroma is largely developed. In the specimen *a* the interradiial tubercles, up to the fifth or sixth, cover with their bases the entire height of their plates so as to leave very little room for its globular granules, but on the sixth or seventh plate from below and the following, *Tab. 7, fig. 1,* the aboral part becomes more and more free and is occupied by an assemblage of conspicuous, glossy, semi-pellucid, rounded, slightly deformed, unequal, sub-pedunculated projections closely overhanging the scrobicular circles, penetrating between them and re-appearing at the adoral margin. Laterally, above the tubercles of the two or three first series, they take the shape of lengthened vertical swellings; towards the inner end of the plate they diminish and become less densely packed, leaving nearly bare a small triangular sutural space. This is where the tubercles are all developed. On the upper plates of the non-adult specimens, where the tubercles are still forming or deficient, they inwardly diminish into slightly raised knobs densely coalesced into a swelling layer and disposed into more or less conspicuous transverse rows radiating towards the sutures or more or less directed towards the middle suture, *Tab. 7, fig. 2.* In the calycinal system of the adult the epistroma takes this form, and its striation, from its highest part on each costal, half way between the pore and the periproct, is directed divaricatingly towards the margin. On the zone of pores its large glossy granules appear on the sutural and aboral margins of each demi-plate, and on the compound plate

arrange themselves, largely developed, in angular arcs bordering on the middle suture, thus filling the narrow open areola, *Tab. 7, fig. 1*. Ventrally, where this areola contracts they gradually disappear.

In colour the Linnean specimens are slightly different, probably from difference of age and from bleaching. The specimen *a* is dull white with a very faint tinge of rose; the calyx grey; the interradiial disks present a slight shade of brownish grey with a lighter line along the suture; the tubercles white with the mamelons green; the zones brick-coloured; the under side whitish all over. The specimen *b* is of a light grey with a slight tinge of rose, a rather vivid red tint traversing from beneath the pellucid granules; the very slight shades on the disks somewhat bluish, with the middle sutural line reddish; the mamelons greenish, a few of them red; the zones light crimson. The specimens *c* and *d* are dull white, the interradia grey, bordering upon livid, the sutural line pale reddish; the mamelons greenish, some reddish; the zones reddish brown.

LINNÆUS said that his *Echinus Lixula* like the three preceding species was not to be found in any author, and referred to the *E. saxatilis* the fig. *A* on the fourteenth plate of RUMPHIUS, which likely enough may have been meant for it. In 1752 he was still ignorant of KLEIN's book. Fourteen years later, when for a long time he had not again seen the original specimens of the Queen's Museum and had no opportunity of comparing them, he got a sight of its French translation of 1754, and in the S. N. ed. 12, p. 1103 erroneously referred to the *E. Diadema* one of the figures given there, Pl. VI, fig. *C*, which is an imitation of KLEIN's Pl. XI, fig. *A*. Had he been able, when first describing the *E. Lixula*, to compare the figures given in the original edition, fig. *A*<sup>1)</sup> and *C*, I think he could not have failed to recognise in both the species he had before him. It is the same marked smallness of the tubercles, their conspicuous rarity on the upper parts, and the same ambulacral areola, even the adventitious tubercles are not missing. One of the type specimens in KLEIN's col-

1) I shall not venture to give any opinion on the fig. *B*, at p. 21 referred together with the fig. *A* to the var.  $\alpha$  of the *Cidaris assulata pustulosa*. Its greater size, its convexity and crowded tubercles forbid its association with the fig. *A*, while the small stoma removes it from any known species of *Arbacia*. It is not unlikely that the marginal letters p. 21 have been misplaced, and that the fig. *B* alone belongs, as a bad figure, to  $\alpha$ , *pustulis densis*, and fig. *A* with *C* to  $\beta$ , *pustulis rarioribus*.

lection preserved in the Museum of the University of Erlangen, the one of which sixteen years ago TROSCHER gave a very accurate description as *Echinocidaris pustulosa* LESKE, now is before me, *Tab. 3, fig. 6*, thanks to the kind liberality of Professor SELENKA. It has been supposed to be the original of KLEIN's fig. *C*, but seems to me to accord as well if not better with his fig. *A*. Its upper side is in a good state, but the basis much broken. It is somewhat flattened, the height being 18 mm., or 0,43 of the diameter of 42 mm., which is lower than in any of the three larger Linnean types, but with this difference it has all the characters of the *A. Lixula* L. The tubercles, very slightly larger than those of the specimen *a*, are somewhat smaller than those of the specimen *b*, their increasing rarity on the upper parts is as striking, and the adventitious tubercles are very nearly as in KLEIN's figure *A*; the ambulacral areola is linear but distinct, and beset with epistromal nodules as in the type specimens, and the epistroma of the interradia is quite as strongly developed. The general colour is a little darker than in the Linnean specimen *b*, the mamelons greenish, the zones chesnut. In short, the differences observable between the two types are individual; in each they are specific with the regard to the other known members of the genus.

LESKE's description of his *Cidaris pustulosa*, which, however, is made, as usual, not from the originals of KLEIN but from specimens in the collections of TRIER and LINCK, agrees very well with the types of the *A. Lixula* L. It alludes to the epistroma and the prominent nib of the gill-supports.

TROSCHER expressly says that he had seen no other specimen than the Kleinian one of the Erlangen Museum, and gives the coast of Brazil as its habitat. But neither KLEIN nor his commentator LESKE indicate the habitat of any of the species they describe, and TROSCHER cannot but have borrowed »Brazil» from the »Catalogue Raisonné» of AGASSIZ and DESOR, where it occurs for their *Echinocidaris pustulosa*. This, however, is not the species described under that name by LESKE, while, on the other hand, the only *Arbacia* known to inhabit the Brazilian coast is not the *A. Lixula* of LINNÆUS. Thus we have to go elsewhere to find the source from which were derived the types in the Queen's Cabinet. Out of the first set, in this collection, of fourteen species, one, the *E.*

esculentus, was undoubtedly from the west coast of Sweden, while the remaining thirteen were all inhabitants of the tropical seas of the old world, mostly those of the East Indies. But from that region not a single species of *Arbacia* has been known with any degree of certainty. DUNKER was surely deceived when he set down as from Australia the species afterwards described by TROSCHEL as *Arbacia australis*; just as the *A. æquituberculata* BLV. has been offered me as »from China».

On the tenth plate of his third volume SEBA gave several figures of *Arbaciæ* that ought to have arrested the attention of LINNÆUS, had not, in 1760, when he first saw the book, time effaced the recollection of the specimens he had described eight years before. Allowing for the rather conventional and sketchy manner of execution of SEBA'S engravings in general, his figures 15 *a, b*, appear to have rendered in a tolerable degree the characters of their originals, and if these are sought for among the species at present known, there is none that answers better than the *A. Lixula* of LINNÆUS. It is as if a specimen intermediate between his largest specimen and that of KLEIN had been lying before the artist; there is the same form of the ambulacra, the same smallness of the tubercles. The description, deplorably inadequate as every other in that work, has nothing but a worthless remark upon the magnitude of the stoma, and an exaggerated statement about the colouring, in which crimson is said to be prevalent, as in bleached specimens like *c* among the Linnean types.

Regarding the habitat of the objects figured in SEBA'S book a hint is sometimes given in the text, but in this instance it is all but lost in confusion. Out of the first fifteen numbers of the plate, three or perhaps four, 1, 2, 6, 7<sup>1)</sup>, are »African», two: 3, 4, »indigenous», and one: 5, »from the East Indies», while the remaining nine, among them the four figures of *Arbaciæ*, are without any locality. Immediately after the few words touching the fig. 15, comes this line: »The eight species hereafter following have been sent me from the coast of Guinea in Africa». There are just eight more numbers on the plate, 16 to 23, and these, accordingly, ought to have either no habitat affixed, or one that falls within the Bight of Guinea. But only four, the three *Echinometræ*, 16, 17, 18,

1) No 7, an *Echinoneus*, is given under the same head as No 6 which is »African».

and the *Echinocardium*, 21, are said to be from the »Insula D. Thomæ», off Gaboon, while the *Brissus*, 19, is without any habitat, and the *Echinus*, 20, the *Metalia*, 22, and the *Echinolampas*, 23, are severally stated to have come from the East Indies. Now, as this is inconsistent with the words premised, and as all the numbers of the text respectively answer to those of the plate, it must be that the line quoted above has been misplaced. The only way of giving it a reasonable meaning is transferring it to between the numbers 7 and 8. Then it comes to stand at the head of eight numbers, 8 to 15, all without any localities, and consequently all representing inhabitants of the Bight of Guinea, among them the four *Arbacia*.

Already in the middle of the seventeenth century the Dutch had settlements on the Gold Coast and for a time possessed the island of São Thomé. No doubt industrious collectors were at work there as everywhere, and dealers were busy distributing among amateurs the natural curiosities of Western Africa, the *Rotulæ* were widely spread, and the »Guineesche Toot», the *Conus genuanus* L., is enumerated by SCHYNVOET and VALENTYN among rarities.

Professor RICHARD GREEFF of Marburg, whose good fortune it has been to visit those regions so rarely seen by naturalists<sup>1)</sup>, had the kindness to send me some species of Echinoids which he had collected at São José, and others from Liberia. Among them were specimens of the *A. Lixula* L., *Tab. 3, fig. 7, 8*. The specimen most closely agreeing with the Linnean types, *fig. 7*, is not fullgrown, having a diameter of only 25 mm. and a height of 12,5 mm. or 0,5. It has thirteen plates; the second series of interradial tubercles attains the second and third plate from the calyx, the third series the fourth and sixth, the fourth the eighth. It shows in a striking manner the characteristics of the Linnean *A. Lixula*, the small tubercles, the ambulacral areola with its well-developed granules, and its epistroma is even more luxuriant than in any of the typical specimens; *Tab. 7, fig. 2*. In these it is, on the calycine system, finely granulated and slightly tumid, in the specimen *c* alone it presents here and there a coalescence into coarser granules. In the one Liberian specimen these concretions form,

<sup>1)</sup> GREEFF, Die Insel São Thomé. Petermanns Mittheilungen, XXX, I, p. 121.



on the costals above the pores and around them, and on the radials, prominent knobs and more or less twisted ridges, while on the sides the striation divaricates as usual. The projecting nib of the gill-supports is there, and the colour is the same as in the Linnæan types *c* and *d*.

Along with these and some other Guinean specimens of the true *A. Lixula* L. there are a few others from São Thomé of a peculiar aspect, *Tab. 3, fig. 9*. While the specimen just described presents a local maximum of luxuriance in its epistroma, these are remarkable for showing that feature near its minimum. None of them are full-grown. The largest among the denuded has a diameter of 30 mm. with a height of 14 mm. or 0,46; another has respectively 21 mm. and 11 mm. or 0,52. In both the smallness of the tubercles is conspicuous. The larger of them has fourteen plates in the interradius 5, and of the five series of tubercles the second reaches to the fourth plate from the calyx, the third to the fifth and sixth, the fourth to the sixth and seventh, the fifth to the eighth. Consequently, the disks of the interradia being partly bare, there is an indication of a star. To this, however, there is an approximation in the typical specimen *c*, *fig. 5*. It is in both made apparent by the minuteness of the new-formed tubercles, and it seems that the peculiar aspect of the specimens from São Thomé depends merely on the development of the tubercles being more retarded relatively to the growth of the other parts of the skeleton. In accordance with this the epistroma, while laterally raised into the characteristic ridge-like granules overhanging the margins of the larger scrobicular circles, is condensed on the disks and on the calyx into the continuous, here rather thin and divaricatingly striated layer always seen in halfgrown specimens. As in such the ambulacral areolæ are rather narrow. The colouring is upon the whole the same as in the old Linnæan specimens, only much fresher, the bluish tint of the grey being more vivid and the zones chestnut. The spines, equalling about half the diameter, are bluish or reddish, pale at the base, and yellow-tipped. The upper ones on the ambulacra are short and sub-cylindrical, then all become aciculate and slender. The basal ones are flattened with the terminal crustule whitish, short, tapering, with a single, strong, rarely bifid, rib. I have no doubt the spines of the Linnæan originals were like these. The figure

5, *Tab. I g*, of ALEXANDER AGASSIZ' Revision seems to come very near to this form.

The opportunity I have had of seeing authentic specimens of all the rarer species, induces me to make an attempt to review the whole genus. In so doing I shall follow the elder AGASSIZ<sup>1)</sup> who made use of a character to which already BLAINVILLE called attention, and divide the *Arbaciæ* into two groups, one for the species in which the adult bears spines all over, up to the calyx, the »subgenus» *Tetrapygius* AGASS., and the other for the species in which the unarmed disks form »a star», the »subgenus» *Agarites* AGASS.

To the former of these groups pertain five species, which from a careful comparison I think are severally distinct and not to be united into one or two species. They represent the Atlantic type of the genus, four of them inhabiting the Atlantic coasts of the Old and New World, while one alone has been found on the Pacific shores of America.

By general agreement the *Echinus æquituberculatus* described by BLAINVILLE in 1825 has been identified with the only European now well-known species inhabiting the Mediterranean and the Eastern Atlantic, at the Canaries, the Cape Verde Islands and the Azores. In his *Actinology*, of 1834, BLAINVILLE inserted a figure of it, which, no doubt by mistake, was inscribed *E. pustulosus*, the name of one of the two very doubtful Lamarckian species he had adopted, and which has since been given promiscuously to four or five different species. The *Arbacia æquituberculata* BLV. differs from the other four in having, in the adult, the ambulacral tubercles so closely contiguous as not to give room for an areola.

The four specimens from which TROSCHEL drew up the description of his *Echinocidaris africana* are before me. As appears from the dimensions he gives, a diameter of from 15 mm. to 22 mm., they are all young. They were collected on the Gold Coast by FINSCH, and belong to the Museum at Bonn from which they were kindly lent me by Professor BERTKAU. From Professor EDW. VON MARTENS of the Berlin Museum I received two specimens from Novo Redondo on the coast of Loanda, presented by the German African Com-  
pany, both marked with the same number, 2063. One of

<sup>1)</sup> Monogr. Scutelles, Obs. s. l. progrès, p. 7, 1841. — C. R. p. 49, 1846.

them is a very young specimen not to be distinguished from the smallest of the four typical specimens; the other a nearly full-grown specimen, 38 mm. and 24 mm. This v. MARTENS is inclined to regard as an adult *E. africana* TROSCHEL; in which I entirely agree. He says it attains the dimensions of 47 mm. and 26 mm. The difference in the relation of height to diameter, 0,63 in the adult and 0,44 in the young is perfectly consistent with the general rule. The ambulacral areola is, as usual in young specimens, very narrow, as pointed out by TROSCHEL; the faint »star», observed by him, comes from the somewhat retarded development of the second and third series of the interradial tubercles, and is seen in the young of any species.

I have compared the original of TROSCHEL's elaborate description of his *Echinocidaris australis*, a fine specimen from the collection of the late Professor WILHELM DUNKER of Marburg; with a specimen from Rio Janeiro sent me by ALEXANDER AGASSIZ as »*Arbacia pustulosa*» and another from »Three fathoms Bay» near that place, and can find no specific difference whatever. The habitat Australia given by DUNKER must be erroneous, as before said.

The *Arbacia grandinosa* of VALENCIENNES rests on the figures given in the Zoology of the Voyage of the Venus, 1836—1839, Zoophytes, Pl. XI, fig. 1 a—n, 1846. Its description was never published. The ship touched on its voyage out at Rio, and then at Valparaiso, Lima, Payta, Acapulco, Monterey, New Zealand, and at other places in the Pacific and Indian Oceans. The »Zoophytes» figured, all Echinoidea and Gorgoniae, are for the most part from the west coast of America, some from the Pacific and the Indian Ocean, and one from the Falkland Islands. AGASSIZ and DESOR in their »Catalogue Raisonné» recorded the *A. grandinosa* VAL. as present in the Paris Museum, from Peru through GAUDICHAUD, who is also quoted for the *Arbacia spathuligera* and *Echinocidaris nigra*, from Coquimbo and Payta, and who had probably collected them all during his voyage 1830—1833 in the *Hermine*; as neither the *Uranie* nor the *Bonite*, on board both of which he officiated as botanist, touched at Coquimbo. He is not cited for any other habitat in the whole Catalogue. DESMOULINS in 1837 enumerated an *E. aquituberculata* from Peru, apparently the same specimens that soon afterwards

were determined by AGASSIZ as *E. grandinosa*, and given under that name by DESMOULINS in 1869, with Peru for their habitat, as stated by the vender. TROSCHER has Chile, and DE LORIOI writes me that the specimen he formerly had lent TROSCHER and obligingly placed in my hands, had been acquired at Paris from a person who was sure of its having been brought from Peru. Add to all this, last but not least, that the 27th plate in the Voyage of LAPEYROUSE, redeemed from oblivion by TROSCHER, is inscribed: »Echinoids from the N. W. coast of America», and contains figures, 4—9, obviously representing the *Arbacia grandinosa* VAL., and it becomes certain that the original of VALENCIENNES really came from the Pacific coast of America, and that the other habitat given in the »Catalogue Raisonné»: Carthagena, the sea-port of New-Granada, on the Caribbean side, is a mistake probably caused by the confounding in the Paris Museum of the species with that called australis by TROSCHER and pustulosa by some authors, which lives on the coast of Brazil and presumably also nearer the Isthmus on its eastern side. It being so, the *A. grandinosa* VAL. is to be regarded as a representative, on the Pacific side, of the Atlantic type of *Arbacia* bearing spines all over, just as the *Echinometra* Van Brunti AL. AG., and another form, are representatives on the Pacific side of the *E. Lucunter* L. of the Atlantic, and the *Meoma grandis* of the *M. ventricosa*, not to mention numerous other instances of representative Mollusks, Crustaceans and other animals, now well known to appear on both sides in nearly related forms.

The Pacific Ocean type of *Arbacia* is exhibited by the species presenting a dorsal »star», that is in which the five disks of the interradia are without spines and more highly coloured. Four of them live on the western coast of America, while one alone is Atlantic. The *A. Dufresnei*, first described by BLAINVILLE, and the *A. alternans* TROSCHER, in both of which the unequal development of the tubercles is very conspicuous, are the southern species, inhabitants of the Straits of Magellan and the coast of Chile. They are succeeded on the coasts of Peru and the Isthmus by the *A. spathuligera* VAL. and at Payta, Panama, California by the *A. stellata*.

The close affinity between the *Arbacia stellata* BLV. and *A. punctulata* LAMCK. has been more than once remarked upon. The former comes nearer to the latter than to the

allied species of its own type on the Pacific side. They resemble each other in general appearance and colouring, in the length of their aciculate spines and the extension of the terminal crustule of the ventral ones. The *A. punctulata* is the true Atlantic representative of the type developed on the Pacific side, just as the *A. grandinosa* is the representative on that side of the type prevailing in the Atlantic. The appellation *punctulata*, alluding to the epistroma of the interradial disk, has been sanctioned by tradition for this Atlantic form; now ascertained by AL. AGASSIZ to be distributed from Yucatan to Long Island Sound. From LAMARCK's description the species is hardly to be recognised, and even less so from his referring to the specimen from the Bight of Guinea in SEBA, t. 10, f. 10 *a, b*, which, after all, present none but generic characters. It seems to have been traced out on account of the doubtfully alleged figure *D* on KLEIN's Pl. XI, afterwards, however, referred by LAMARCK to his *E. pustulosus*. No doubt that figure somewhat recalls the *A. punctulata* of authors, and is quoted for it by TROSCHER from the French edition of KLEIN's work, but the small mouth expressly noticed by KLEIN hardly admits of an identification, the less so as in that species the stoma is fully as large as in any other member of the genus. It is also not to be overlooked that the original of the fig. *D* was not in KLEIN's own collection but belonged to the »Thesaurus Regius» at Dresden, from whence LESKE afterwards had it for comparison<sup>1)</sup>. The specimens of the *A. punctulata* LAMARCK., therefore, of the Erlangen Museum, which TROSCHER described, and which are now before me, may have once been in the possession of KLEIN, but none of them can have served as an original to the fig. *D*. Consequently this figure must be set aside for the present.

Among the names in use within this genus the two following ought to disappear:

The name of »*pustulosa*», taken from KLEIN, was given by LESKE and TROSCHER to the *Arbacia Lixula* L., by LAMARCK and BLAINVILLE to some form not to be made out now, by DESMOULINS in 1837 to the *Echinocidaris nigra* MOL., in 1869 to the *Arbacia grandinosa* VAL., and by AGASSIZ and DESOR

<sup>1)</sup> Addit. p. 152. Professor H. B. GEINITZ writes me that, if still extant in 1849, they were destroyed when the wing of the »Zwinger» was burnt down, which contained the zoological collections.

to the *A. australis* TROSCHEL, while ALEXANDER AGASSIZ comprehended under it all the species, spinigerous all over, that were known to him. It has not the right of primogeniture and has been sadly misapplied.

The other is *Arbacia loculata* BLV. KLEIN had given, at *D* on his plate XI, the figure of his »*Cidaris assulata* spec. V, *pustulosa*  $\gamma$ »), distinguished from  $\alpha$ ) fig. *A*, *B*: »*pustulis densis*... »*ore magno*», and from  $\beta$ ) fig. *C*: »*pustulis rarioribus*, *ore sinuoso*», by the words: »*pustulis rarissimis*, *ano et ore parvis*». LESKE<sup>1)</sup> says the figure *D* completely agrees with the original specimen, and keeps it apart from his »*Cidaris pustulosa*» represented by the figures *A*, *B*, and *C*. LAMARCK<sup>2)</sup>, quotes it for two different species. BLAINVILLE<sup>3)</sup>, after having duly referred these, came to the conclusion that the figure *D* represented some other distinct species unseen and unknown to him, which he described from that figure alone, naming it *E. loculatus*. This appellation was adopted by DESMOULINS<sup>4)</sup> for a species in his collection, received through RANG from the elder d'ORBIGNY, and said to inhabit the Atlantic coast of France and the Channel, and by AGASSIZ and DESOR<sup>5)</sup>, who transcribed its habitat and noted its affinity to the *E. stellatus* of BLAINVILLE. In 1869 DESMOULINS<sup>6)</sup> still held the same opinion, until shortly afterwards in the same year PAUL FISCHER<sup>7)</sup> made known the fact that COTTEAU also had received from the same d'ORBIGNY a specimen of the same species, which had been taken from the bottom of a vessel careened at La Rochelle, and beset with shells of *Spondylus* and *Chama*. Thus DESMOULINS' *E. loculata* was found out to be an exotic, perhaps an *A. Lixula* from Liberia<sup>8)</sup>. TROSCHEL once thought to have recognised it in a species from western Africa, but soon gave it up and called that species »*africana*». From all this it follows that the name »*loculata*», invented for a hypothetical species nowhere to be found and never to be identified, is best consigned to oblivion.

1) Addit. p. 152.

2) An. s. Vert. III, p. 47, 49.

3) Dict. sc. nat. XXXVII, p. 75; 1825.

4) Etudes, p. 36, 306; 1835, 1837.

5) C. R. p. 49, 1847.

6) Actes Soc. Lin. Bordeaux, XXVII, p. 162.

7) Ib. p. 271.

8) AL. AG. Rev. 403.

## Arbacia GRAY.

- \* Interradia undique spinigera. — Tetrapygus AG.
- a. Areola ambulacralis tecta, verrucarum seriebus binis ubique contiguis.
1. *A. æquituberculata* BLV., hemisphærica, depressiuscula, verrucis confertis, interradiatorum seriebus utrinque sex; epistromatis granulis validis, densatis. *Tab. 8; T. 9, fig. 1-6.*
1825. *Echinus æquituberculatus* BLV. *Dict. Sc. Nat., XXVII,*  
p. 76.
- » 1837. PHILIPPI, *Arch. Nat.,*  
III, p. 245, t. 5,  
f. 8, 9.
- Echinocidaris* » 1846. AG. DES. C. R., p.  
50, t. 15, f. 3.
- » 1869. DESMOULINS, *Act.*  
*Soc. Lin. Bordeaux,*  
XXVII, p. 162, t.  
11, f. 5, 6.
- » 1872, 1873. TROSCHE, *Arch.*  
*Nat., XXXVIII, p.*  
308; *XXXIX, p.*  
335.
1834. *Echinus pustulosus* BLV. *Actinol. t. 20, f. 2, non p. 226.*
- Arbacia* » 1872-1874. AL. AG., *Rev.*  
p. 92, 402.
1841. *Echinus neapolitanus* DELLE CHIAJE, *Descriz. e Notomia,*  
IV, p. 32, V, p. 120,  
t. 118, f. 11-22.

Habitat mare Mediterraneum, et Atlanticum ad insulas Canarias, Capo-Verdenses, Azoreas.

TESTA ambitu leviter pentagonula, hemisphærica, depressiuscula, altitudine in adultis 0,51, 0,42, in junioribus 0,43, 0,38 diametri.

Basis planiuscula, ad interradia leviter tumida; stoma longitudine 0,53 diametri testæ.

CALYX costalibus obtusis, poris sexualibus magnis juxta apicem.

AMBULACRA leviter prominula, angusta, propè ambitum 0,31 interradii; in basi modice dilatata, demissa, vix immersa, zonæ latitudine 1,63 fulcri,

VERRUCÆ confertæ, magnitudine mediæ:

Ambulacrorum series binæ contiguæ;

Interradiatorum series utrinque sex, primæ verrucæ juxta ambitum ambulacralibus vicinis nonnihil minores, secundæ—quartæ sensim majores; series unaquæque præcedente una l. altera assula brevior, sexta brevissima.

EPISTROMA dense granulosum:

In ambulacris vix ullum, superne inter verrucas rare emergens, globulosum;

In interradiis basi inconspicuum, globulosum, supra ab ambitu inde ubique validum, ad latera luxurians;

In calyce subtile, divaricato-punctulatum.

SPINÆ dimidiam testæ diametrum excedentes; ventrales breviores, leviter planulatæ, crustula apicis pallida, submarginata, cristis plerumque binis, brevibus, simplicibus.

COLOR brunneus, interradiis disco rubentibus, calyce nigricante, verrucis pallide concoloribus, mamilla virescente, rufo obducta, zonis sanguineis, spinis nigro-purpureis.

MENSURÆ: diam. 47,5 mm. altit. 20 mm.

»	46	»	»	20	»
»	41	»	»	21	»
»	35	»	»	13,5	»
»	26	»	»	10	»
»	20	»	»	10	»

b. Areola ambulacralis aperta, linearis, acuta, verrucarum seriebus binis discedentibus.

2. **A. africana** TROSCHEL, subconico-hemisphærica, verrucis grandiusculis, interradiatorum seriebus utrinque quatuor, secunda et tertia superne deminutis, epistromate valido.

1873. Echinocidaris africana TROSCHEL, Arch. Nat., XXXIX, p. 327.

Habitat in sinu Guineæ maris atlantici, ad litus aureum dictum (Mus. Bonnense), ad Novo Redondo Angolæ (Mus. Berlin).

TESTA ambitu orbicularis, subconico-hemisphærica, altitudine 0,63, 0,44 diametri, latere in adulto large rotundato.

Basis vix planiuscula, ad interradia tumida; stoma longitudine 0,55 diametri testæ.

CALYX costalibus subrectangulis, poris sexualibus modicis, rotundatis, apici propioribus.



AMBULACRA prope ambitum latiuscula, 0,39 interradii æquantia, in basi modice expansa, leviter demissa, paullum immersa zonæ latitudine 1,25 fulcri.

VERRUCÆ grandiusculæ, superne rariusculæ:

Ambulacrorum series binæ non multum discedentes latitudine dimidium scrobiculum non æquante; verrucæ eminulæ

Interradiorum series utrinque quatuor; primæ verrucæ juxta ambitum ambulacrales vicinas paullum superantes, secundæ tertiæ illis paullum majores, hac superne citius deminuta quartæ minutæ supra ambitum pusillæ; series unaquæque præcedente assulis binis l. tribus brevior.

EPISTROMA validum, varie granulosum:

In ambulacris rariusculum, informiter globulosum, pæne semicirculans;

In interradiis validum, elatiusculum, superius interne demissum, deminutum, per strias crassiusculas transversas vix divaricatas;

In calyce subtile, divaricatum.

SPINÆ robustæ, breviusculæ, dimidiam diametrum testæ non æquantés; basales planatæ, crustula apicis brevi, pallida cristis tribus, duabus, una l. altera nonnumquam bifida.

COLOR obscure viridis, ambulacris pallide roseis, verrucis interradiorum niveis, mamilla viridi, zonis badiis; spinæ atrovirides

MENSURÆ: diam. 38 mm., altit. 24 mm.

» 22,5 » » 10 »

3. **A. Lixula** L., hemisphærica, verrucis minusculis, interradiorum seriebus utrinque septem; epistromate luxuriante  
*Tab. 3; T. 7, fig. 1, 2.*

KLEIN, Disp. p. 21, Cidaris assulata, species V, pustulosa,  $\beta$ ) t. XI, f. (A), C, orig., 1734. — Id. ed. gall. p. 60, t. VI, f. (C). D. imit. f. (A), C Kleini, 1754. — SEBA, Thes., III, p. 20, t. X, f. 15 a, b, orig., 1758.

1758. Echinus Lixula L. S. N. ed. 10, p. 664.

» » » 1764. M. L. U., p. 707.

» » » 1767. S. N. ed. 12, p. 1102.

1778. Cidaris pustulosa LESKE, Addit., p. 150, t. XI f. (A), C Kleini.

Arbacia » » 1872. Al. AGASSIZ; Rev. t. I, g fig. 5

*Echinocidaris pustulosa* LESKE, 1872. TROSCHEL, Arch. f. Nat., XXXVIII, p. 308; XXXIX, p. 332.

1827. *Echinus margaritaceus* BORY DE ST. VINCENT, Enc. Méth. I, p. 142, t. 141, f. 6, imit. Klein.

Habitat in Sinu Guineæ Maris Atlantici, ad litora Liberiae, Insulae S. Thomæ (GREEFF).

TESTA ambitu leviter pentagona, hemisphaerica, altitudine 0,61, 0,53, 0,41 diametri.

Basis modice planata, ad interrada tumidiuscula, stomatis longitudine 0,57 diametri testæ; fulcra branchialia breviuscula, angulo medio prominulo.

CALYX costalibus subrectangulis, poris sexualibus subovatis, apici propioribus.

AMBULACRA prominula, angusta, prope ambitum 0,30 interradii latitudine æquantia, in basi dilatata, demissa, vix immersa, zonæ latitudine 1,25 fulcri.

VERRUCÆ minusculæ, ordinibus transversis supra remotiusculis:

Ambulacrorum series binæ discedentes, areola intermedia lineari acuta, latitudine dimidium circum scrobicularem aliquid excedente;

Interradiatorum series utrinque septem, novissima, serotina, septima extus adventicia infrequente; primæ verrucæ prope ambitum ambulacralibus vicinis æquales, secundæ—quintæ sensim paullo majores, sexta æquali; series unaquæque præcedente assula una l. altera brevior, intima brevissima.

EPISTROMA luxurians, ubique validum, varie granulolum:

In ambulacris per semicirculos subsuturales dispositum;

In interradiis circa verrucas presse collectum, ad margines crassius, informiter coalescens, prope suturam mediam deminutum, subæqualius, densum, turgidulum;

In calyce subtile, divaricato-punctulatum.

SPINÆ graciles, dimidiam diametrum testæ superantes; ambulacrales superiores tres l. quatuor breves, subcylindricæ; ventrales planatæ, crustula apicis attenuati albida, brevi; crista singula, lata.

COLOR obsoletus, pallide l. sordide roseus, interradiis disco offuscatis; verrucæ albida, mamilla virescente, zonæ sanguineæ.

MENSURÆ: diam.	45 mm.,	altit.	25 mm.
»	42 »	»	18 »
»	40 »	»	24,5 »
»	32 »	»	17 »
»	29 »	»	12 »
»	27 »	»	14,5 »

4. **A. australis** TROSCHEL, hemisphærica, gibba, verrucis modicis, interradiatorum seriebus utrinque sex, epistromate valido.

1872. *Echinocidaris australis* TROSCHELI. Arch. Nat. XXVIII, p. 309; XXXIX, p. 345.

1846. » *pustulosa* LAMCK. AG. DES. C. R. p. 50, non LESKE, non LAMARCK, non DESMOULINS.

Arbacia » » 1872. AL. AGASS. Rev. p. 92, 402.

• Habitat ad oras ~~Brasilie~~ *Australie* ~~missi uniuscuius generis~~

TESTA ambitu orbicularis, hemisphærica, gibba, altitudine 0,59, 0,50 diametri æquante.

Basis planiuscula, ad interradia tumidula; stoma longitudine 0,52, 0,50 diametri testæ.

CALYX costalibus obtusis, poris sexualibus majusculis, apici approximatis.

AMBULACRA angusta, juxta ambitum latitudine 0,32 interradii, basi modice dilatata, demissa, vix immersa, zonæ latitudine 1,23 fulcri.

VERRUCÆ mediæ magnitudinis, confertæ, supra remotiusculæ:

Ambulacrorum series binæ discedentes, areolæ latitudine dimidium circulum scrobicularem æquante;

Interradiatorum series utrinque sex; primæ verrucæ prope ambitum ambulacralibus vicinis æquales, secundæ—quartæ sensim paullo majores, quinta subæquali; series unaquæque præcedente assulis duabus l. tribus brevior, sexta, intima brevissima.

EPISTROMA ubique validum, variè granulosum:

In ambulacris informiter globulosum, par semicirculos subsuturales dispositum;

In interradiis verrucis circumstipatum, ad margines crassius, coalescens, prope suturam mediam deminutum, æqualius;

In calyce subtilissimum divaricato-striolatum.

SPINÆ dimidiam testam fere æquantes; basalium crustula apicis longe marginata, cristis binis, tribus, interdum unica.

COLOR cinereo-fuscus, interradiis disco offuscatis, calyce nigricante; verrucæ pallide concolores, mamilla virescente, rubro tincta; zonæ obscure sanguineæ.

MENSURÆ: diam. 59 mm., altit. 34 mm.

» 56 » » 28 »

5. **A. grandinosa** VAL., hemisphærica, verrucis modicis, interradiatorum seriebus utrinque quinis, quarta et quinta citius deminutis, epistromate valido.

1846. *Echinus grandinosus* VAL. Voy. Venus, Atl. Zool., Zooph. t. XI f. 1 a—n.

*Echinocidaris* » » 1846. AG. DES., C. R. p. 50.

» » » 1872. 1873. TROSCHEL, Arch. Nat. XXXVIII, p. 308; XXXIX, p. 341.

1872. *Arbacia pustulosa* AL. AG. Rev. p. 92, 402.

Habitat ad oras Americæ occidentalis, ad litus Peruanum (DE LORIO, DESMOULINS).

TESTA ambitu levissime pentagona, hemisphærica, altitudine 0,53 diametri.

Basis planiuscula, ad interradia vix tumida; stoma longitudine 0,60 diametri testæ.

CALYX costalibus subrectangulis, poris sexualibus mediocribus, apici approximatis.

AMBULACRA prope ambitum latiuscula, 0,40 interradii æquantia, in basi modice dilatata, demissa, paullum immersa, zonæ latitudine 1,38 fulcri.

VERRUCÆ mediæ magnitudinis, in basi confertæ, superne rariusculæ:

Ambulacrorum series binæ non multum discedentes, distantia dimidium scrobiculum haud æquante;

Interradiatorum series utrinque quinæ; primæ verrucæ prope ambitum ambulacralibus vicinis fere æquales, secundæ, tertiæ nonnihil majores, quartæ, quintæ cito deminutæ; series unaquæque præcedente assulis duabus l. tribus brevior.

## EPISTROMA validum:

In ambulacris globulosum, simplici serie semicirculatum;  
In interradiis validiusculum, supernè medio demissum, divaricatum;

In calyce subtile, divaricatum.

## SPINÆ?

COLOR saturate badius, verrucis pallidis, mamillis virescentibus rubro tinctis; zonis obscure sanguineis.

MENSURÆ: diam. 40 mm., altit. 20 mm.

\*\* Interradiorum discus longe lateque inermis epistromate minutissime granuloso obtectus. Agarites AG.

a. Verrucæ mire inæquales; ambulacra versus stoma manifesto dilatata; crustula apicis spinarum basalium brevis.

6. **A. alternans** TROSCH., sub-hemisphærica, verrucis mire inæqualibus, interradiorum seriebus utrinque tribus, secunda et tertia prope ambitum terminatis, prima superne alternatim deminuta, epistromate prope verrucas primas sub-conspicuo.

1872. Echinocidaris alternans TROSCH. Arch. f. Nat. XXXVIII, 1, p. 307; XXXIX, p. 323.

» » » 1880. STUDER, Mon. Ber. Akad. Berlin, p. 867.

Arbacia Dufresnei BLV. 1872--1874, AL. AG. Rev. p. 91, p. 399,

» » » 1874. AL. AG. Results Blake, I, p. 6, t. 1, f. 3, 4; non BLV.

Habitat fretum Magellaneum et oram Chilensem ad insulam Chiloë (SCHEELE, Mus. Ups.).

TESTA ambitu orbicularis, sub-hemisphærica, altitudine 0,50 diametri æquante, interradiis regulariter convexis;

Basis sub-plana, ad interradiâ vix tumida; stomatis longitudine 0,60 diametri testæ.

CALYX costalibus obtusis, poris mediocribus apici propioribus.

AMBULACRA prope ambitum 0,44 interradii, in basi modice dilatata, zonis leviter demissis, vix immersis, latitudine 1,6 fulcri.

VERRUCÆ mire inæquales:

Ambulacrorum binæ series inferius aliquid discedentes, deinde contiguæ; verrucæ ab infimis ad ambitum et ultra

magnitudine auctæ, tum abrupte deminutæ, passim nullæ, passim fere restitutæ, denique in altera serie solum residuæ, minimæ, passim evanidæ;

Interradiatorum series utrinque tres; primæ verrucæ ad ambitum usque normales, tum una abrupte pusilla, deinde alternatim plene restitutæ aut majores, denique minimæ; secunda series superne assulis quinque l. sex illa brevior, tertia assulis novem; verrucæ secundæ usque ad assulam sextam regulariter auctæ, tum abrupte et valde deminutæ; seriei tertiæ, brevissimæ, minores, in assula quinta minimæ.

EPISTROMA subconspicuum, varium:

In ambulacris superne per lacunas verrucarum globulos formans deformes, zonis superductum;

In interradiis prope verrucas majores globulos efficiens paucos majusculos subito condensatos in stratum æquum, discum tegens muticum amplum, deorsum dilatatum;

In calyce subtile, divaricato-radiatum.

SPINÆ primordiales et ad ambitum omnes sub-graciles, longitudine dimidiam testam circiter æquantes, superius alterne minutæ subclavatæ, obtusæ, inferne breviores, planulatæ, crustula apicis albida, brevi, vix marginata, crista unica l. duplici.

COLOR læte viridis, calyce fuscescente, zonis fuscis, verrucis niveis mamilla virescente.

MENSURÆ: diam. 28 mm., altit. 15 mm.

» 25,5 » » 13 »

7. **A. Dufresnei** BLV., sub-hemisphærica, verrucis perquam inæqualibus, interradiatorum seriebus utrinque quatuor, inde a secunda prope ambitum subito deminutis, secunda sola continuata, epistromate circum verrucas primas conspicuo.

1825. Echinus Dufresnei BLV. Dict. Sc. nat. XXXVII, p. 76.

Echinocidaris » » 1872, 1873, TROSCHEL Arch. f. Nat. XXXVIII, I, p. 307; XXXIX, I, p. 319.

1857. Echinocidaris Scythei PHILIPPI, Arch. f. Nat. XXIII, I, p. 131.

Habitat ad oras Chilenses Americæ occidentalis, ad Puerto Month prope insulam Chiloë, Fretum Magellaneum, oras Patagoniæ orientalis (STUDER).

TESTA ambitu suborbicularis, sub-hemisphærica, altitudine 0,50 diametri æquante, interradiis concavis;

Basis planiuscula, ad interradia leviter tumida, stomatis longitudine 0,55 diametri testæ.

CALYX costalibus subrectangulis, rotundatis, poris medio-cribus apici propioribus.

AMBULACRA prope ambitum 0,34 interradii, in basi modice dilatata, leviter demissa, aliquid immersa, zonæ latitudine 1,4 fulcri.

VERRUCÆ perquam inæquales:

Ambulacrorum binæ series ubique contiguæ; verrucæ inde ab infimis ad ambitum usque magnitudine sensim auctæ, tum in altera serie, superius in utraque, abrupte deminutæ, passim restitutæ, denique in altera serie sola residuæ;

Interradiorum series utrinque quatuor; prima normalis, superne modo serius decrescens, secunda assulis duabus illa brevior, tertia assulis sex, quarta brevissima assulis septem. Verrucæ secundæ usque ad assulam decimam, tertiæ ad assulam nonam l. octavam, quartæ ad quintam l. septimam magnitudine auctæ, tum abrupte et mire deminutæ, secunda serie sola continuata. Sicut in *A. lixula* ita et in hac specie verruca adventicia externa singula minuta occurit in assulis 2 a 8 et 2 b 9, 3 a 8 et 3 b 8, 4 a 8, nulla vero in 1, 4 b, 5.

EPISTROMA conspicuum, varium:

In ambulacris superne ad latera globulos formans crassiusculos; zonis superductum;

In interradiis granula formans prope verrucas majores pauca, majuscula, subito in stratum condensata æquum, subtilissime granulosum, discum amplum tegens deorsum dilatatum, supra ambitum obtuse truncatum;

In calyce subtile, divaricato-radiatum.

SPINÆ primordiales; ut ad ambitum omnes, robustæ, longiusculæ, dimidiam testam superantes, superne reliquæ brevissimæ, subtumidæ, subcylindricæ, obtusæ; sub ambitu planulatæ, crustula apicis albida, brevi, vix marginata, cristis sæpius duabus, altera interdum bifida.

COLOR viridis, in discis saturatior, calyce fuscescente, zonis pallide fuscis, verrucis niveis, mamilla virescente.

MENSURÆ: diam. 40 mm., altit. 20,5 mm.

8. **A. spathuligera** VAL. hemisphærica, verrucis perquam inæqualibus, interradiatorum seriebus quinque, inde a secunda prope ambitum subito deminutis, secunda sæpius cum tertia sola continuata; epistromate circum verrucas valido. *Tab. 7. fig. 3.*

1846. *Echinus spathuliger* VALENCIENNES. *Voy. Venus, Atl. Zooph. t. V, f. 2, a—g.*

*Echinocidaris* » » 1846. *AG. et DES. C. R. p. 49.*

» » » 1867. VERRILL, *Trans. Conn. Acad. I, 2, p. 300.*

» » » 1872, 1873. TROSCHEL, *Arch. f. Nat. XXXVIII, p. 309; XXXIX, p. 348.*

*Arbacia* » » 1872—1874. *AL. AG. Rev. p. 93, 403.*

Habitat ad oras Americæ occidentalis, ad Puntas Arenas Sinus Nicoyæ (Mus. Hamburg), Peru (WARBERG, Mus. Holm).

TESTA ambitu leviter pentagonula, hemisphærica, altitudine 0,58 diametri æquante.

Basis planiuscula, ad interradia tumida, stomatis longitudine 0,55 diametri testæ.

CALYX costalibus obtusis, poris sexualibus majusculis, apici propioribus.

AMBULACRA prope ambitum 0,35 interradii; in basi modice dilatata, demissa, aliquid immersa, zonæ latitudine 1,4 fulcri.

VERRUCÆ perquam inæquales:

Ambulacrorum binæ series in basi paullum remotæ, ad ambitum contiguæ, deinde aliquantum discedentes; verrucæ inde ab infimis minutis usque ad ambitum magnitudine auctæ, tum abrupte deminutæ, sursum sensim decrescentes, in altera serie denique evanidæ;

Interradiatorum series utrinque quinæ; prima normalis, secunda assula unica illa brevior, tertia assulis tribus l. quatuor, quarta assulis septem, quinta brevissima assulis octo; verrucæ secundæ usque ad assulam octavam, tertiæ ad septimam, quartæ ad sextam, ab infimis inde magnitudine auctæ, tum abrupte et mire deminutæ, serie secunda et tertia solis continuatis.

EPISTROMA validum, varium:

In ambulacris inferne repressum, ad ambitum vix ullum, superius inter deminutas verrucas subito prominens granulis



crassis, informibus, remotis, inæqualibus, denique raris; lateralibus;

In interradiis superne circum verrucas granosum validum, inæquale, informe, abrupte in stratum condensatum æquum, subtilissime granulosum, discum muticum oblongum tegens;

In calyce subtilissimum punctato-divaricatum.

SPINÆ primordiales ad ambitum omnes subulatae, robustiusculæ, diametrum testæ dimidiam æquantes, superne reliquæ brevissimæ, subcylindricæ, obtusæ; inferiores planulatæ, subspathulatæ, crustula apicis albida, brevi, vix marginata, cristis sæpius duabus brevibus, interdum duplicatis.

COLOR umbrinus, interradiis disco et zonis obscuris, calyce fusco, tuberculis pallidis mamilla virente.

MENSURÆ: diam. 64 mm. altit. 37 mm.

»	42	»	»	25	»
»	37	»	»	21	»

b. Verrucæ modice inæquales; ambulacra versus stomapum dilatata; crustula apicis spinarum basaliū longa.

9. **A. stellata** BLV., hemisphærica; depressiuscula, verrucarum interradiarum seriebus utrinque binis, prima valida eminente, secunda abbreviata; epistromate represso, ad verrucas inconspicuo. *Tab. 9, fig. 6, 7.*

1825. *Echinus stellatus* BLV. *Dict. Sc. Nat.*, XXXVII, p. 76.

*Echinocidaris* » » 1846. *AG. DES. C. R.* p. 49.

» » » 1867. VERRILL, *Tr. Conn. Acad.* I, I, p. 298.

» » » 1872, 1873, TROSCHEL, *Arch. f. Nat.* XXXVIII, p. 308; XXXIX, p. 316.

*Arbacia* » » 1872—1874, *AL. AG. Rev.* p. 93, p. 404.

1864. *Echinocidaris longispina* LÜTKEN, *Bidr.*, p. 130, t. 1, f. 7.

Habitat ad Panama Americæ occidentalis (KINBERG, BOVALLIUS), S. Francisco (FORRER, DE LORIOI).

TESTA ambitu subpentagona, hemisphærica, depressiuscula, altitudine 0,45 diametri æquante, interradiis leviter concavis.

Basis vix planulata, ad interradia parum tumida, stomate amplo, longitudine 0,60 diametri.

CALYX costalibus subacutis, poris sexualibus minusculis apici proximis.

AMBULACRA prope ambitum latiuscula, 0,53 interradii, in basi parum dilatata, demissa, nonnihil immersa, zonæ latitudine 1,12 fulcri.

VERRUCÆ validæ, eminentes, superius scrobicula mire artata, mamilla tarde deminuta:

Ambulacrorum binæ series presse contiguæ; verrucæ inferne minutæ; ad ambitum per bina l. tria paria maximæ, tum citius deminutæ, superne evanidæ;

Interradiorum series utrinque binæ; primæ verrucæ grandes, eminentes, præsertim supra ambitum, tarde decrescentes, denique citius deminutæ; secunda series assulis quinque illa brevior, subito deminuta.

EPISTROMA prope suppressum, nec sublatum:

In ambulacris ad latera areolæ superne muticæ costulam formans angustam alternatim in nodulos intumescentem;

In interradiis prope verrucas evanidum, in disco subtilissimum, stratum efficiens undique æquum, ad suturas quasi celatas conspicuum, zonis distincte superductum;

In calyce distinctum punctura subtili, nodulo unico in radiali quoque.

SPINÆ validæ, subulatæ, diametrum testæ longitudine æquantes; crustula apicis prope concolor, longa, 0,26—0,36 longitudinis totalis attingens, superne attenuata, concava margine inflexo, crista media longa, rarius duplicata aut etiam evanida.

COLOR pallide roseus l. cinerascens, verrucis albidis mamilla virescente, epistromate discorum rubro large maculosum, zonis obscuris.

MENSURÆ: diam. 20 mm. altit. 9 mm.

10. **A. punctulata** LAMCK., subconico-hemisphærica verrucarum interradiarium seriebus utrinque tribus, secunda vel tertia abbreviatis, epistromate manifesto. *Tab. 7, fig. 4.*

1816. *Echinus punctulatus* LAMCK., An. s. Vert., III, 47.

» » » 1825. BLV. Dict. sc. nat. XXXVII, p. 75.

Echinocidaris » » 1846. AG. DES. C. R. p. 49.

» » » 1863. LÜTKEN, Bidrag, p. 29.

1816. *Echinocidaris punctulata* LAMCK., 1869. DESMOULINS, Actes  
Soc. Lin. Bordeaux,  
XXVII, t. 10, f.  
1, 2.

» » » 1872, 1873, TROSCHEL,  
Arch. f. Nat.  
XXXVIII, p. 306,  
XXXIX, p. 310.

*Arbacia* » » » 1872—1874, AL. AG:  
Rev. p. 91, 263,  
t. 2 f. 4, t. 5, f.  
1—18.

Habitat ad oras Atlanticas America borealis, a Long Is-  
land Sound ad Yucatan (AL. AGASSIZ).

TESTA ambitu pentagonulo-orbicularis, hemisphærica, in-  
terdum subconica, altitudine 0,57, 0,55, 0,53 diametri æquante,  
lateris flexu large rotundato, interradiis disco levissime de-  
missis.

Basis vix planulata, sub-pulvinata, ad interradia nonnihil  
tumida, stomate amplo, longitudine 0,59, 0,54 diametri.

CALYX costalibus sub-rectangulis, poris sexualibus minuscu-  
lis apici approximatis.

AMBULACRA latiuscula, prope ambitum 0,41 interradii, deinde  
versus stoma parum dilatata, demissa, immersa, zonæ latitudine  
1,07—0,9 fuleri.

VERRUCÆ validæ, e minore parte abrupte deminutæ:

Ambulacrorum binæ series in junioribus et sub-adultis con-  
tiguæ, in ætate propectis discedentes, distantia dimidium scro-  
biculum haud æquante; verrucæ ad ambitum interradiis  
vicinis vix minores, superius altera serie subito deminutæ  
vel evanidæ, altera passim continua;

Interradiatorum series utrinque tres; ad ambitum usque et  
ultra verrucæ omnes validæ, secundis et tertiis aliquid majori-  
bus; series secunda assulis quatuor prima brevior, tertia assulis  
sex; secunda ad assulam decimam, tertia ad octavam subito  
deminuta, deinde evanida.

EPISTROMA manifestum:

In ambulacris, ætate propectis solis, conspicuum, granulis  
validiusculis, inæqualibus, parum confertis semicircularis;

In interradiis, basi minutum globulis acervatis, prope  
ambitum verrucas cingens etiam tertias, supra eum primas

solum circulo fere simplici, subito demissum, et in stratum condensatum æquum, granulis punctatum minutis, transverse dispositis, leviter divaricatis;

In calyce subtile, divaricatum.

SPINÆ longæ, robustæ, aciculatæ, diametro testæ non multum breviores; ambulacrales superiores tres l. quatuor breves, crassiusculæ, leviter curvatæ et compressæ, basales abbreviatæ, sub-spathulatæ; crustula apicis marginata, utrinque descendens, longa, quartam partem longitudinis totalis attingens, cristis sæpius quatuor, brevibus.

COLOR in recentibus cæsius, vetustate pallescens, in roseum et violaceum vergens, verrucæ albidæ, mamilla virescente, zonæ obscuræ.

MENSURÆ: diam. 42 mm. altit. 21 mm.

»	39	»	»	22	»
»	38	»	»	21	»
»	35	»	»	20	»

The two species numbered 6 and 7, *Echinus saxatilis* L. and *E. Diadema* L., were regarded by LINNÆUS as closely related, and are to be considered simultaneously. But first of all the original reading of the diagnosis of the No 7 must be restored. The *Systema Naturæ*, ed. 10, 1758 p. 664 and ed. 12, 1767, p. 1103, No 7, have: »ambulacris quinque longitudinaliter verrucosis; areis lanceolatis», and the *Mus. Lud. Ulr.*, 1764, p. 709: »areis quinque lanceolatis, ambulacris longitudinaliter verrucosis». All this is without meaning and evidently perverted. The notes from the lectures of 1752 accord in giving, from the dictation of LINNÆUS: »ambulacris quinque lanceolatis; areis longitudinaliter verrucosis. Vulgo Diadema». When compared with the description in the *M. L. U.*, and the diagnosis of *E. saxatilis*, this reading comes forth as the only true one.

In one point the descriptions of these two species present a very remarkable deviation from the method used throughout for the other *Echini Regulares*. While, when these are described, »TESTA», »AMBULACRA», and »AREÆ» follow continuously one upon another, LINNÆUS has here inserted between »Testa» and »Ambulacra» a supplemental description of the dorsal and ventral aspects, drawn up in terms nowhere else

## 6. ECHINUS SAXATILIS L.

ECHINUS hemisphærico-depressus, ambulacris dentibus paribus approximatis, areis longitudinaliter verrucosis.

Prælect. 1752 et M. L. U.

*Rumph. mus. 31. t. 14. f. A. Echinus saxatilis.*

S. N. ed. 10 et 12 add.

*Klein Echinod. 17, t. 2, f. A, B. (ed. germ. 1734).*

S. N. ed. 10 et 12.

*Habitat in M. Mediterraneo.*

Simillimus sequenti; sed Magnitudo minor et Figura magis depressa.

TESTA hemisphærico-rotunda.

Centrum supra perforatum foramine magno, cui circumstant puncta 5 perforata.

Radii 5 duplici serie punctorum prominentium: lateribus minutissimis punctis perforatis.

Utrique lateri adstat series punctorum majorum prominentium, inferne sparsorum.

## AMBULACRA

in medio serie duplici punctorum elevatorum.

Pori ad latera utrinque duplici serie, subtus etiam obvii.

AREOLÆ 4 ordinum longitudinalium.

Cætera eadem.

7. ECHINUS DIADEMA L.

Tab. 4.

ECHINUS hemisphærico-depressus, ambulacris quinque lanceolatis; areis longitudinaliter verrucosis. Vulgo Diadema.

S. N. ed. 10 et M. L. U.

*Rumph. mus. t. 14 f. B.*

*Pet. amb. t. 8. f. 5, Echinus s. Diadema turcarum.*

S. N. ed. 12, add.

*Klein Echinod. t. 6, f. C. (ed. gall. 1754, imit. t. XI, f. A, ed. germ., 1734.)*

S. N. ed. 10 et 12.

*Habitat in M. Indico.*

TESTA orbiculata, subglobosa, supra depressa, lateribus rotundata, gibba, divisa in areas, 5 ambulacris.

*Supra:* Centrum subrotundum, cinctum Area pentagona angulis perforatis.

Radii 5 convexi, serie duplici punctorum eminentium, lateribus minutissime punctati.

Punctorum majorum eminentium series utriusque lateri radiorum adjacet.

*Subtus* eadem, sed scabrities minus ordinata.

AMBULACRA lanceolata, areis elevatiora.

In medio series 4:plex punctorum elevatorum.

Ad latera utrinque multiplex pororum ordo.

Qui ordines subtus inspecti obliquis seriebus ex 6 poris.

AREÆ submuricatæ: verrucis 6 ordinibus longitudinalibus:

verrucae læves, conicæ, ambitu lævi, apice perforatæ.

used for the same parts in the Regulares. By this means these two species are made to stand out united, for themselves, from among the others.

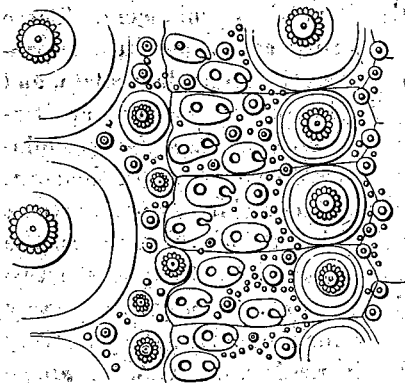
No specimen referable to the *E. saxatilis* exists in the collection, and since its printed label is found lying at the *E. Lucunter* L., it is probable that it was lost before 1790. But of the species set down as *Echinothrix Turcarum* by ALEXANDER AGASSIZ, there is a fine specimen, *Tab. 4, fig. 1, 2, 3*, signed in THUNBERG's hand: »Mus. Gust. Ad.», to indicate its having come from the Queen's Cabinet. It is doubtless the type of the *Echinus Diadema* L. It will be found convenient to take it into consideration previous to the other.

The test of the *E. diadema*, says the description, is slightly tumid all around the depressed centrum. The periproct is nearly orbicular, slightly oval. The ambulacra, called radii in the supplement, are not, as usual, ten in number, but five as in the *E. Cidaris*. Thus the term »ambulacrum» is here made to embrace not only the two zonæ poriferæ, but also the space between every two of these, or what LINNÆUS elsewhere calls »area angustior» or »areola». This is the acceptation of the term now in use. Dorsally the ambulacra are lanceolate, convex and elevated above the interradia. Between their two lateral series of secondary tubercles, the middle space or discus presents up to quadruple rows of tertiary tubercles. The pedicellar pores are multiple, not forming a simple series, and below, near the peristome, arranged in diagonal rows of six, that is of three geminous pores. On their outside, the zones of pores are accompanied by a series of »larger» tertiary tubercles, continued on the under side, but there less regular: »minus ordinata», the word »subtus» taken as referring solely to the »Puncta...», evidently not to the »Centrum...» or the »Radii...». On the interradia are scattered minute tertiary tubercles, and the large primary tubercles form six vertical rows, three on each half; they are conic, their scrobicular circles are smooth, not beset with small tubercles round the margin like those of the *E. Cidaris*, and the mamelon is perforated.

In the *E. Diadema* L. thus described, recent authors, as ALEXANDER AGASSIZ and BÖLSCHE, who quotes the M. L. U., recognised a species of the genus *Echinothrix* PETERS. The perforated mamelon is decisive with regard to the family, while

the genus is determined by the form of the ambulacra. These are broad near the peristome, narrow at the ambitus, expanding again upwards, so as to become inversely lanceolate, and raised above the interradia. Their compound plates are ternary, and the three geminous pores, which are disposed diagonally in the broad, slightly concave ventral part of the zone, become more longitudinal towards the ambitus, and above it form faintly arched triads. On its inner side each zone has the vertical series of secondary tubercles. Ventrally these two series are very close together, leaving room for only two sparsely alternating rows of granules; towards the ambitus they slightly separate, the tubercles slowly increasing. Somewhat above that point these begin to diminish again, and at the same time to diverge from one another, while in the interjacent space, the discus, which thus widens upwards and contracts again only close to the »centrum», there are gradually introduced new vertical crowded series of more minute tertiary tubercles, forming transverse rows, alternating from right and from left, and concealing the middle suture. The uppermost three or four newly formed plates are bare. In the typical specimen the number of small tertiary tubercles in a transverse row across the disk, between the somewhat larger marginal ones, increases to four. A young specimen of 40 mm. has only two, a number seen also in some adult specimens, but this difference hardly ought to be regarded as of specific value. The broad interradia, with the large primary tubercles forming at the ambitus six series, present in the narrow interstices left by the flat expanded scrobicules, diminutive tertiaries in winding rows, of size as far as there is room. Laterally and closely bordering upon the zona is thus formed, on each plate, a regular vertical series of slightly curved arches, which under the ambitus become more strongly marked, more dense, and nearly straight, but more irregular. With the exception of these series there is not to be found anything answering to the words of the supplemental description: »Punctorum majorum eminentium series utrique lateri radiorum adjacet, subtus eadem sed scabrities minus ordinata». The accordance would be perfect, were it not for the word: »majorum», — but true it is that the tubercle at the upper angle of each plate is somewhat larger than the rest. The words are repeated of *E. saxatilis*, and this same disposition of the





Part of the ambulacrum of *E. Diadema*, showing the lateral series of larger tertiaries.

marginal tertiary tubercles on the interradia is seen in all the Diadematidæ. In *Centrostephanus* there are three such series between the zone and the primordial series of tubercles.

It is readily seen that LINNÆUS regarded the *Echinus Diadema* as the principal species of the two, and that he first drew up its description from the larger and more instructive specimen, and then

that of the other, the *E. saxatilis*, treating this less circumstantially and rather summarily. He says it closely resembles the *E. Diadema*, but is of a smaller size. Its primary tubercles he describes as forming four, not six series in every interradium, but »cætera eadem», that is: their mamelons are perforated as in that species. From this character, which is set down as common to both, being distinctive of the Diadematidæ; from the resemblance of the two species to each other insisted upon throughout, and from the care that is taken to keep them jointly apart, it follows that the *Echinus saxatilis* L. is also a member of that group. While in the *E. Diadema* the ambulacra, that is the zones, are combined by pairs into five »radii», convex, elevated and lanceolate, they are simply counted separately as ten in the *E. saxatilis*, the pairs only being approximated. In both species the ambulacra present two vertical series of tubercles, but in the interjacent space there are in the *E. saxatilis* two series of tertiaries, not four. Unlike what is said of the pores in the *E. Diadema* it is here stated that they are placed in a double row, that is a simple row of geminous pores, and are met with also on the ventral side, »subtus etiam obvii», which cannot but mean that they are there arranged in the same manner, or nearly so, as on the dorsal side, that is: not in diagonal rows of three pores as in *E. Diadema*. A disposition like this, in simple rows, when looked for among other Diadematidæ, is nowhere found under the ambitus in full-

grown specimens, which always have the dorsal pores disposed by triads, in slightly curved longitudinal arches that on the ventral side become diagonal. But the specimen from which LINNÆUS described his *E. saxatilis* was assuredly not fullgrown. He says: »magnitudo minor», and refers to RUMPHIUS, t. XIV, f. A., in 1752 to that figure alone, chiefly, it may be presumed, with regard to its size, 27 mm. in diameter. Thus the *E. saxatilis* L. ought to be looked for in the young of some species of the group. Its diagnosis excludes the genus *Echinothrix*, *Astropyga* deviates by its general form and the numerous series of its interradiæ primary verrucæ, as does *Centrostephanus* by their whole disposition, and we are led to the genus *Diadema* GRAY and to its long-known species of world-wide inter-tropical distribution, the *D. setosum* GRAY.

If the diagnosis and description of the *E. saxatilis* are tried on a young specimen of the *Diadema setosum* GRAY, 25 mm. in diameter, the result will be as follows.

The general form, »figura», is hemispherical and round, and more depressed than that of the *E. Diadema*. Of the general form the term »depressus» is used thrice in the whole of the Echinoids: for these two *Diadematidæ*, and for the *E. Cidaris*. If it is understood to mean flattened, its combination with »hemisphæricus» and »globosus» would involve a contradiction, but it must be strictly taken in the sense given to it in the *Philosophia Botanica*<sup>1)</sup>. Thus understood it is clearly seen specially to refer to the region of the »centrum», which in the *Cidaridæ* is more or less flattened, and in the *Diadematidæ* almost characteristically sunk, and nowhere more so than in the *Diadema setosum* GRAY.

The periproct compared with that of the *E. Diadema* is large: »foramine magno». Its long diameter, 1—3, is 0,53 of that of the calyx, 0,14 of that of the test. The corresponding measures in the *E. Diadema* are 0,516 and 0,126.

The ambulacra, that is the zonæ poriferæ are ten in number, placed two and two close together, their well-known disposition in the *Diadema setosum* GRAY. The expression: »paribus approximatis» is used also of *Arbacia Lixula*, and the narrow ambulacra, in particular the disposition of the zonæ in that species so much resemble the same parts in the young *Diadema saxatile*, that the figure A on the Pl. XIV in RUM-

<sup>1)</sup> See above p. 58.

PHIUS, quoted by LINNÆUS for his *E. saxatilis*, was looked upon by LAMARCK as probably intended to represent an *Arbacia punctulata*, and by BLAINVILLE and DESMOULINS as referable to the mythical *A. loculata* BLV., approximations that TRÖSCHEL<sup>1)</sup> regards as more than doubtful. — Like those of the *E. Diadema* the ambulacra of the *E. saxatilis* present two latéral series of secondary verrucæ, and between these not four but two rows of tertiary verruculæ. In the young *Diadema setosum* GRAY, as well as in the adult, there are two regularly alternating rows of sparse and minute but very conspicuous tertiary verrucæ, one such being placed at the sutural angle of each compound plate.

The pedicellar geminous pores I understand to be arranged in a simple series continued also on the under side. In the small specimen of *Diadema setosum*, the pores dorsally form a nearly rectilinear series, and ventrally their arches are still all but longitudinal, so as to exhibit a slightly flexuous series, which is doubled only on the first two or three plates, but as yet nowhere trebled as in the full grown animal. To this juvenile disposition it seems to me that LINNÆUS adverts in the words: »Pori duplici serie, subtus etiam obvi» contrasted with the »obliquis seriebus ex sex poris» of the *E. Diadema*.

Each zone of pores is accompanied close on its outside by a series of tertiary verrucæ said to be »larger», which are »spread» on the under side. The same is said of the *E. Diadema*, where »sparsa» is replaced by »minus ordinata». It has been shown already that this passage would render completely the row of minute interradial verruculæ bordering upon the zone and conspicuous in all the *Diadematidæ*, were it not for that word: »majorum». I might suspect the transcriber, only it occurs in both descriptions.

While in the *E. Diadema* the interradia present six vertical series of verrucæ, the description gives only four series to the *E. saxatilis*, and this is their number in specimens of the *Diadema setosum* of the size of the figure A in RUMPHIUS's book.

The »verrucæ», the primary tubercles, are like those of the *E. Diadema*; their mamelon is perforated.

<sup>1)</sup> Arch. f. Naturg., XXXVIII, p. 310.

From this it will have been seen that, allowance made for one single word of no great moment, the diagnosis and description of the *Echinus saxatilis* L. closely agree with the characters exhibited by the young of *Diadema setosum* GRAY, a species of wide distribution and from old time very common in collections. To that species therefore, and to no other, it belongs to bear the Linnean name, as *Diadema saxatile* L.

Reverting now to the supplemental lines intercalated between TESTA and AMBULACRA, they bear like the rest of the description the marks of having been first written down under the *E. Diadema* and then, *mutatis mutandis*, somewhat abridged under the *E. saxatilis*. They have all the appearance of having been drawn up subsequently to the completion of the regular description and with the view of bringing forward the close affinity between these two species as members of a division of their own, distinct from the rest. With the exception of the term »convexi» used of the »radii» in the *E. Diadema*, but left out in *E. saxatilis*, their distinctions are hardly mentioned, while their resemblances are fully indicated. The »ambulacra quina lanceolata areis elevatiora» of the *E. Diadema* are here termed »radii», and the same term is applied also to the »ambulacra dena, paribus approximatis» of *E. saxatilis*. Now it is worth remarking that LINNÆUS counts five ambulacra in all the Irregulares, but among the Regulares only in *E. Diadema* and *E. Cidaris*; that the word »radii» is met with nowhere else among the Regulares, while among the Irregulares it is invariably made use of to designate what we call the petals; that the term »puncta perforata» applied to the »Radii» of the Spatangi, the *E. Spatagus* and *E. lacunosus*, is found also in the remarks on the »radii» of the *E. saxatilis*, while the strictly proper expression: »pori», occurs in the regular description lower down; and that the term »centrum» is used nowhere else among the Regulares, but in the Irregulares everywhere for the same part. Moreover, while nothing like the whole insertion is found in any of the Regulares, its contents are disposed in close accordance with the descriptions of the Irregulares, namely under the heads: *supra*, centrum, radii, and *subtus*.

It cannot be imagined that LINNÆUS had the least idea of the fact that the pedicels of the »five radii» in the *Diadematidæ* and those of the Spatangi, by means of a peculiar

structure nearly similar in both, seem to be made subservient to a similar function, different from that of the ventral pedicels, apparently that of respiration, but with his incomparable keenness of observation and always ready power of reflection, it may well be that when he had come to observe that the mamelons of the Diadematidæ are perforated like those of the Spatangidæ, he looked about for other resemblances and was led to surmise a relation of homology between the convex, dorsally expanding and lanceolate ambulacra of the Echinus Diadema, and the radii concavi a centro deducti, lanceolati of the E. Spatagus, and, in recording his conception of the close affinity between the two Diadematidæ, purposely used for these the terms »radii», »puncta perforata» and »centrum», elsewhere chosen for the Spatangæ and other Irregulares, and, as an innuendo of some distant connexion between the two groups to be taken into consideration on some future day, framed his remarks after the Spatangean model, »ut vel aliqualis horum superesset idea».

The references to preceding authors attached to these two species are such as fully to bear out the expedience of attending principally and above all to the descriptions of LINNÆUS, properly understood, and to look with doubt upon the quotations even as subsidiary means for determining his species. It must be kept in mind that in 1758, when adding new references, he was guided solely by the recollection of the specimens he had seen in 1752, six years before. In the Lectures of that year no quotation is given under the E. Diadema, and under the Echinus saxatilis only RUMPHIUS, t. 14, f. A. As said already, this figure cannot have been cited but with regard to the size and to the disposition of the zonæ; in other respects it is too deficient, it does not show the depression of the centrum particularly laid stress upon, nor the perforation of the verrucæ. SCHYNVOET, the editor of the Rariteit-Kammer, says in the note on p. 32: »The Echinus saxatilis stands upon t. XIV, fig. A, though somewhat smaller (»doch wat kleinder») to which I have added one of the sort called with us the Turkish Turban, fig. B, very rare, both together communicated by Dr d'ACQUET». SCHYNVOET, it appears, could not make out the Echinus saxatilis of RUMPHIUS, of which there existed no authentic specimen, and of which there was

no figure in the manuscript sent from Amboina. It seemed to him, however, that a small Echinoid presented by D'ACQUET<sup>1)</sup>, in whose collection were numerous objects given by RUMPHIUS, might come near the sort had in view by this author, and he had it figured at *A* on the fourteenth plate and in the note referred to it without reserve as the *Echinus saxatilis*. But as it was rather of an insignificant size, he added, as *B*, the figure of another specimen, received also, and along with the former from D'ACQUET, of the sort known under the *nom de guerre* of the Turkish Turban. He does not say that he regarded the two to be of one and the same sort, but the whole of the note seems to me to imply that the fig. *B* was inserted in order to make the fig. *A* better understood. It may be said to represent tolerably well a specimen of *Diadema setosum* GRAY of the same size. Now, this figure *B*, with its copy in PETIVER'S Amboina, in the S. N. ed. 10 and ed. 12, and in the M. L. U., is quoted under the *E. Diadema*. It is, however, obvious that it cannot possibly have been drawn from a specimen of that species.

The depression of the »centrum» and the swelling of the surrounding parts are considerable, as in the *D. setosum*, compared with the *E. Diadema*; the costals are long, pointed and nearly as in the *D. setosum*, not short and rounded as in the *E. Diadema*; the periproct, large and irregularly quadrangular, is more like that of the former, and but little resembles the rounded one in the latter; the ambulacra are by no means represented as being convex, raised, lanceolate, and extending like rays from the centre as in that species, their breadth, far from increasing from the ambitus toward the »centrum», is represented as decreasing in that direction, as in *D. setosum*; the verrucæ of the interradia are not conspicuously large as in *E. Diadema*. It is true, the verrucæ of the double rows in the ambulacra are not as large as in corresponding specimens

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<sup>1)</sup> The introductory letter in which RUMPHIUS intrusts his friend D'ACQUET with the editing of the »Rariteit-Kammer», begins: »Some years already we have corresponded, in particular about Shells, and I have sent You most of their sorts, as many as I have been able to collect.» . . . »I have illustrated the work with artistical delineations which I hope will have Your approbation». The publisher, HALMA, in his dedication to D'ACQUET says that many figures promised by the author had never come to hand, and had been replaced by others from specimens in various cabinets, particularly that of D'ACQUET, all through the care of SCHYNVOET.

of *D. setosum*, and on the other hand the verruculae between them are somewhat too large, but in those days the demand for accuracy of detail was easily satisfied. It therefore appears to me as an indubitable fact, that the figure *B* on the plate XIV in RUMPHIUS represents a specimen of the *E. saxatilis* L. and not one of the *Echinus Diadema* L. Of this latter no figure exists in the old authors, and it appears to have been unknown until described by LINNÆUS. In lecturing on the Echinoidea in the autumn of 1752, then fresh from his work at Drottningholm, he did not refer to any figure, at least none of the four manuscripts alludes to any, and it may be supposed that the reference to the fig. *B* of RUMPHIUS under the *Echinus Diadema* has been added in preparing the S. N. ed. 10, 1758, when perhaps six years had passed since he had seen the specimen in the Queen's Cabinet, and at a time when he had no opportunity of comparing it again, — if it be not, as seems to me more likely, that it was simply misplaced.

Another recognisable figure of the *E. saxatilis* L., in D'ARGENVILLE's work, 1742, fig. *D* on the 28th plate, was erroneously bestowed on the *E. mamillatus*, and is to be restored to its due place. But two references to KLEIN are to be entirely rejected, namely the one added in 1758 under the *E. saxatilis*, referred by LAMARCK to his *E. miliaris*, and the one from the French translation appended in 1767 to the *E. Diadema*, mentioned above under the *E. Lixula* L.

Having dictated to his auditory in 1752 the diagnosis of his sixth species of *Echinus*, LINNÆUS added: »is called *saxatilis*», and this »nomen triviale» became its name in the S. N. ed. 10, 1758. It is taken from p. 31 in RUMPHIUS. It is, however, very easy to perceive that the Echinoid there alluded to is something widely different from the one that is figured as *A* on t. XIV, and which RUMPHIUS certainly had not in view. The sort, or rather the sorts he had before his eyes in Amboina he describes as oblong (»langwerpig»), thick-shelled, with tubercles larger than those of his »*esculentus*»<sup>1)</sup>, and with longer spines, strong enough to make it very difficult to lay hold of the animal, living as it does in the cavities of corals and growing there until it cannot be extracted, — traits all of them decidedly pointing towards the *Echinometra*. This was the interpretation adopted in 1770 by HOUT-

<sup>1)</sup> See above p. 63.

TUYN<sup>1)</sup>, who published an original figure of a small specimen, and in 1775 by STATIUS MÜLLER<sup>2)</sup>, who copied it and in his turn referred to KNORR's<sup>3)</sup> figures, evidently of some Echinometra, and such was also the view taken in 1778 by LESKE<sup>4)</sup>, who altered the name to *Cidaris rupestris*, — all of them being persuaded that they had before their eyes the true *Echinus saxatilis* of LINNÆUS. But at the same time O. F. MÜLLER<sup>5)</sup>, in 1776, and O. FABRICIUS<sup>6)</sup>, in 1780, had conferred that name upon the Greenlandic *Strongylocentrus drøbakensis*, widely distributed in the north, and they were followed by NILSSON<sup>7)</sup>, in 1817, while GMELIN<sup>8)</sup> in 1788 took upon himself to render the confusion irremediable by exchanging the diagnosis given by LINNÆUS for a new and entirely different one of his own making, thus causing TIEDEMANN<sup>9)</sup> in 1817 to bestow the name *saxatilis* L. on the *E. lividus* LAMCK. of the Mediterranean, with which LAMARCK himself<sup>10)</sup> in 1816 had thought of associating that supposed Linnean species.

The habitat, »Mare Mediterraneum», given to the *E. saxatilis* in both editions of the S. N., may have had its share in this dreary confusion. It seems a mystery whence it has crept into that work. By the not depressed but prominent region of the »centrum», by the presence of two, not of four series of interradial primary verrucæ, as by other characters, the rare *Centrostephanus longispinus* PHILIPPI deviates from the description too widely to be thought of. It appears to me very likely that the »M. Mediterraneum» is a copyist's blunder for »M. Meridionale», the name used for the South Sea at No 16.

### Diadema saxatile L.

SCHYNVOET in RUMPH. Amb. t. XIV, f. B, orig., 1705. — PETIVER, *Diadema turcarum*, Amb. t. VIII, f. 5, imit. RUMPH., 1713. — SLOANE, *Jam.*, II, p. 267, t. 243, orig., 1725. — SCHYNVOET, *Diadema turcarum*, *Thes. imag.* t. XIV, f. B, rep. RUMPH., 1739. — D'ARGENVILLE, *Conchil.*, ed. 1, t. 28, f. E, orig., 1742; ed. 2, t. 25, f. D, orig., 1757. — (AUBERT DE LACHESNAYE DES BOIS) KLEIN, *Ordre naturel*, p. 232, t. XXVII, orig., 1754.

<sup>1)</sup> *Natuurlyke Historie*, XIV, p. 503, t. 114, f. 1.

<sup>2)</sup> LINNÉ's *Natursystem*. VI, p. 149, t. 8, f. 1.

<sup>3)</sup> *Deliciæ*, I, t. D1, f. 8, D3, f. 6.

<sup>4)</sup> *Addit.* p. 111, t. 5, f. a, b, c.

<sup>5)</sup> *Zool. Dan. Prodrömus*, p. 305.

<sup>6)</sup> *Fauna Grœnl.* p. 372.

<sup>7)</sup> *Collectanea*, p. 9.

<sup>8)</sup> *Syst. Nat.* ed. 13, I, VI, p. 171.

<sup>9)</sup> *Anatomie d. Röhren-Holothurie etc.*

<sup>10)</sup> *Hist. An. s. v.*, III, p. 50.



1758. *Echinus saxatilis* L. S. N. ed. 10, p. 664.  
 1764. *Id.* M. L. U., p. 708.  
 1767. S. N. ed. 12, p. 1102.  
 1770. *Echinus diadema* (*non* L.) HOUTTUYN, Natuurlyke Hist. XIV,  
 p. 505, t. CXIV, f. 2, orig.  
 1775. STARCK & MÜLLER, *Natursystem*,  
 VI; II, p. 150, t. 8, f. 2, imit.  
 Houttuyn: *Id.* p. 517.  
 1777. KNORR, *Deliciae*, ed. 2, p. 85,  
 t. D III, fr. 2, orig.; p. 80, t.  
 D, f. 7, orig.  
 1778. LESKE, *Add.*, p. 14, t. 100, t.  
 XXXVII, f. 1, imit. Knorr;  
 p. 40f, t. XLVI, f. 1, orig.  
 1787. HERBST, *Einl. Würm.* I, p. 91,  
 t. XXIII A, 395, f. 1, imit.  
 Rumph.  
*Cidarites*  
 1816. LAMCK, *An. s. vert.* III, p. 58.  
 1817. BLAINV., *Dict. Sc. nat.* IX, p.  
 200.  
 1827. BORY DE S. VINC., *Enc. méth.*  
 I, p. 142, t. 133, f. 10, imit.  
 Knorr.  
 1830. BLV. l. c. LX, p. 212.  
 1834. *Id.* *Man. d'Act.*, p. 231, t. XX  
*bis*, f. 6, orig.  
 1825. *Diadema setosum* GRAY *Ann. Phil.* X, p. 426.  
 » » 1853. PETERS, *Berl. Ber.*, p. 486.  
 » » 1854. *Id.* *Berl. Abhandl.*, p. 109.  
 » » 1865. BÖLSCHE, *Arch. f. Nat.*, XXXI,  
 I, p. 325.  
 » » 1872. AL. AGASS. *Rev.*, p. 103, 274,  
 t. IVa, f. 1; Va, f. 5.  
 » » 1883. DE LORIOI, *Mém. Soc. Genève*,  
 XXVIII, No 8, p. 13.  
 1837. *Diadema turcarum* DESM. *Etudes*, p. 308.  
 » » 1845. MICHELIN, *Mag. Zool.*, VII,  
 p. 15.  
 » » 1845. AGASSIZ, *C. R.*, p. 45.  
 » » 1853. PETERS, *Berl. Ber.*, p. 488.  
 » » 1854. *Id.*, *Berl. Abhandl.*, p. 116.

1845. *Diadema Savignyi* MICHELIN, Mag. Zool. VII, p. 15.  
 »       »       » 1847. AGASS. C. R., p. 55.  
 »       »       » 1866. v. MARTENS, Arch. f. Nat.,  
           XXXII, p. 155.  
 1845.       »   *Antillarum* PHIL. Arch. f. Nat., XI, p. 355.  
           »       »       » 1863. LÜTKEN, Vid. Medd., p. 83.  
 1847.       »   *Lamarcki* AGASS. C. R., p. 45.  
 1862. *Savignya Frappieri* MICH., MAILLARD, Isle Réunion, A—4,  
           t. XV.

### **Echinothrix Diadema L.**

1758. *Echinus Diadema* L. S. N. ed. 10, p. 664.  
       »       »       » 1764. M. L. U., p. 709.  
       »       »       » 1767. S. N. ed. 12, p. 1103.  
 1774. *Echinus calamaris* PALLAS, Spic. Zool. I, fasc. X, p. 31,  
           t. II, f. 4—8.  
       *Echinothrix*       »       » 1866. v. MART. Arch. f. Naturgesch.  
                                   XXXII, p. 150.  
       »       »       » 1873. AL. AGASS. Rev., p. 120,  
           413, t. III a, f. 1, 2.  
 1845. *Diadema Desjardinsi* MICH. Mag., Zool., VII, Echinod.,  
           p. 13, t. VII.  
 1847. *Astropyga Desori* AGASS. C. R., p. 41.  
       *Echinothrix*       »       » 1872. AL. AG., Rev., p. 120, 415.  
 1865. *Echinothrix turcarum* BÖLSCHE, Arch. f. Nat., XXXI, p.  
           330, t. XIII, f. I, 2.  
       »       »       » 1873. AL. AG. Rev., p. 120, 416,  
           t. III a, f. 3.  
       »       »       » 1883. DE LORIOI, Mém. Soc. Ge-  
           nève, XXVII, No 8, p. 17.  
 1865. *Echinothrix Petersi* BÖLSCHE l. c. 334, t. XIII, f. 3—5.

## 8. ECHINUS CIDARIS L.

Tab. 5.

**ECHINUS globoso-depressus, ambulacris quinque repandis linearibus; areis alternatim bifariam verrucosis.**

## Lectures 1752:

*D'Argenville*, t. 28, f. F.

*Gualtieri*, t. 108, f. D. 1), E.

S. N. ed. 10, 1758, add.:

*Rumph. mus.* 33, t. 13, f. 3, *Echinometra digitata* 2, rotunda.

*Pet. Amb.*, t. 7, f. 2.

*Bonan. mus.*, f. 17.

*Klein, echinod.* 19, t. 7, *Cidaris mamillata mauri* (ed. germanica).

M. L. U. 1764, add.:

*Fauna Suecica*, ed. 2, n. 2118.

S. N. ed. 12, 1767, add.:

*Klein, echinod.* 19, (ed. germ.), t. 4, f. A, (ed. gall.).

*Seba, Mus.* 3, t. 13, f. 12, 13.

*Baster, Op. subs. III*, t. 11, f. 1—6, *Echinus Cidaris*.

Prælect. 1752:

*Habitat*: India orientalis.

S. N. ed. 10, 1758, et ed. 12, 1767:

*Habitat in* Oceano.

*Fauna Suecica* ed. 2, 1761:

*Habitat in* Oceano Norvegico.

The diagnosis here given is from the Lectures of 1752, as it reads in all the four manuscripts. In both the editions of the S. N., of 1758 and 1767, in the F. S. ed. 2, of 1761,

\*) By mistake the notes have *B*, which is a figure of *E. mamillatus*.

and in the M. L. U., of 1764, »hemisphærico-depressus» is substituted for »globoso-depressus». In the M. L. U. the word »linearibus» is omitted, and in the S. N. ed. 10 and 12 the last words are mutilated, thus: »alternatim bifariis», and in the F. S. ed. 2, of 1761, thus: »alternis bifariis».

The Lectures have: »is called Cidaris and comes from the East Indies». In the S. N. ed. 10 and 12 the habitat is: »in Oceano», in the F. S. ed. 2: »in Oceano norvegico».

There is no description.

The two specimens of the genus Cidaris in the Drottningholm collection, both denuded, belong to widely different species. One of them only, *Tab. 5, fig. 1, 2*, answers to the Linnean »globoso-depressus», and is therefore to be regarded as the type of the primitive description afterwards suppressed.

It may be thus described:

TESTA globosa, ambitu sub-pentagono, inferne tumidior, vertice depressa, altitudine 0,75 diametri æquante.

CALYX rotundato pentagonus; costalia depressione transversa notata, granulata, granulis ad marginem aboralem et ad latera pori majoribus; pori sexuales, in 1, 5, 4, 3, ad tertiam partem terminalem, in 2 ad quintam siti, minutiusculi, subtubulosi. Radialia lata, triangularia, superne truncata, inferne emarginata; granulata ut costalia.

AMBULACRA nonnihil impressa, prope ambitum 11,2 mm. lata, 0,29 interradii latitudine æquantia, lanceolata, levisime flexuosa, juxta ambitum fere stricta et linearia. Areola media, in III, juxta 267, 5,2 mm. lata, 0,464 ambulacri latitudine æquans, serie utrinque marginata continua verrucularum primordialium, quarum in assula quivis una, additis prope ambitum minoribus: proxima ad marginem adoralem, altera sub-media, tertia adoralis, quarta sub-suturali<sup>1)</sup>.

INTERRADIA tumida, 38,5 lata; areola media aperta, 0,3 toti, ad summum perducta planiuscula, superne levissime tantum ad suturam impressa; areola lateralis utrinque dimidio fere angustior. Verrucæ in hoc genere exiguæ magnitudinis et numerosæ, 11,5 et 12; scrobiculi duo ultimo fere circulares, reliqui transversim sub-elliptici, supra et infra invicem contigui; verruculæ annulorum minusculæ, confertæ; superiores et inferiores exiguæ quatuor l. quinque serie simplici alterna,

<sup>1)</sup> See woodcut below, p. 143.

laterales majusculæ sex l. septem, utrinque in granula abientes sensim deminuta, per series haud ita distinctas transversas disposita, confertissima, in sutura media minima.

COLOR: griseo-fuscescens ambulacris et calyce saturatoribus.

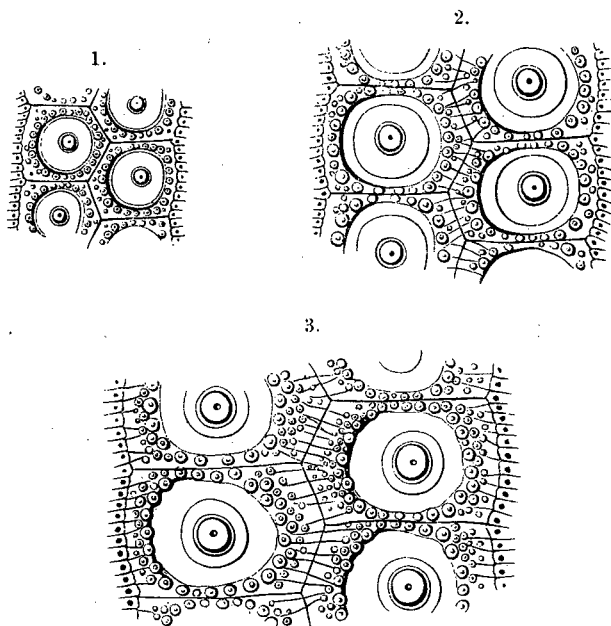
MENSURÆ: diameter 84 mm.; altitudo 63 mm.

The specimen, of a size but rarely seen in collections, is evidently fullgrown, and the specimens, with which it will have to be compared may be expected to be younger and to present differences depending on different degrees of individual development.

The growth of the test of all Echinoids, it is well known, is effected by the addition of new plates at the aboral margin of ambulacra and interradia, combined with the gradual expansion of those already formed, their breadth increasing at a greater rate than the height. In the Cidaridæ the development of the primary verrucæ is simultaneous with that of new plates, every one of these in the act of forming bearing already a primary tubercle with its scrobicule still unexpanded but distinct. Thus there are in all ages as many verrucæ as there are plates in the vertical series, and consequently a less number of primary verrucæ in the interradial series denotes the younger specimens. Similarly, it may be expected that the middle areas, ambulacral and interradial, when found open and broad in the mature specimen, will be seen to be narrower in the young, or even closed, from the scrobicular rings of the two series being still approximated or even contiguous.

When specimens of the *Cidaris papillata* LESKE of various sizes are compared, they are found to present certain conspicuous differences consistent with these relations of the growing parts. A specimen of 24 mm. has the two marginal series of ambulacral primaries closely contiguous above and below, and it is only near the ambitus that they are slightly separating so as to give room, on each plate, for one single secondary verrucula just about to form between them, alternately, close to the suture. In specimens of 41 and 46 mm. these first secondary verruculæ are finished and free, and can be followed to near the peristome, but not equally near to the top. At the size of 54 mm. a second series of secondaries

<sup>1</sup>) AL. AGASSIZ, Revision, Pl. I, f, fig. 2.



*Cidaris papillata* LESKE.

1. diam. 24 mm.    2. diam. 41 mm.    3. diam. 64 mm.  
Part of an interradium.

just begins to appear near the ambitus, and at 64 mm. there are on each plate two well-developed secondaries along the middle part of the ambulacral areola.

The specimen of *C. papillata* 24 mm. in diameter has six primary verrucae in each interradial series, of which the three upper have their rings circular and intact all around, and the three lower have them contracted vertically, while all are contiguous to those of the other series and the zones. At a size of 40 mm., with 7 and 7,5 verrucae in the series, the contraction begins at the 5th from below; at 55 mm., with 8, 8,5 verrucae, at the 5th or 6th; at 64 mm., with 9, 9,5 verrucae, at the 7th or 8th, and thus the relative number of vertically contracted rings in the series increases with age, the upper and the lower sides of the scrobicular ring gradually becoming reduced and straightened. The plates grow at a greater rate transversely than vertically, and likewise at a greater rate than the inner longer diameter of their scrobicules, and consequently, while the rings always remain within

each series contiguous vertically, the two series, which were transversely contiguous in the specimen of 24 mm., are separated, slightly at 40 mm., more so at 54 mm., and rather conspicuously at 64 mm. At the same time

at 24 mm.	the inner diameter of the scrobicule	$5 a 4$	is 0,71	of the plate.
" 40	"	"	"	"
" 54	"	"	"	"
" 64	"	"	"	"

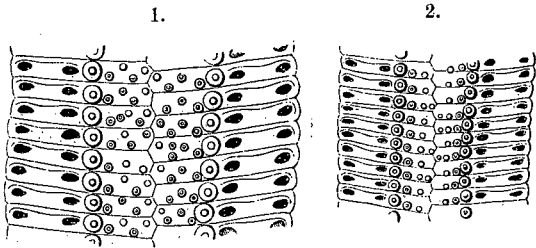
The amount by which the total length of the plate exceeds that of the inner diameter of the scrobicule is nearly equally divided between the two terminal parts of the plate, that is between the middle areola and the two marginal ones that border upon the zones.

Within the calyx of the *Cidaris papillata*, in the specimen of 40 mm., the four costals, 1, 5, 4, 3, are equal and the sexual pore on the outer 0,33 of their radial diameter; the 2, madreporic, is slightly larger and has the pore in 0,3. In the specimen of 64 mm., the costal 1 is very slightly larger than the 5, 4, 3, and in all four the sexual pore is placed at the outer 0,42—0,45 of their radial diameter, while the madreporic costal 2, larger by 0,2, has the pore in 0,235.

It follows that when the type specimen of *Echinus Cidaris* L. is going to be compared with another of the same species, but of an inferior size, it is to be expected that in the smaller specimen the middle areola of the ambulacra will be found narrower and its secondary verruculæ less numerous; and in the interradia that the verrucæ of each vertical series will be less in number; that the two series will be more closely approximated, and thus the middle area less broad; and, in the calyx, that the costals will have the sexual pore nearer to their adoral margin.

The smallness of the interradial primary verrucæ and their great number in each vertical series at once remove the type of the *Echinus Cidaris* L. not only from such as the *C. imperialis* LAMCK., the *C. dubia* AL. AG. or the *C. papillata* LESKE, but also from nearly every other known species of the genus, derived from localities somehow explored at the time of LINNÆUS. In those characters only one among recent species agrees with it, the *Cidaris baculosa* LAMCK. Of this a specimen, of the well known typical form with purple spots on the necks of its spines, now lies before me. It has a dia-

meter of 62,5 mm., and a height of 47 mm., or 0,76, and 10 or 10,5 plates in each interradian series. The test has not as much of the pentagonal form as that of the type, but more than any other species. The ambulacrum III, at the height of the 267 has a breadth of 7,25 mm. or 0,24 of the interradian, and the very slightly concave areola measures 2,75 mm. or 0,38 of the ambulacrum. The plates have, close to the marginal primary verrucula, a small secondary one placed



1. *Echinus Cidaris* L.

2. *Cidaris baculosa* LAMCK.

adorally, followed by another sub-marginal still smaller to which is added here and there a sub-sutural one, thus approximating the mature specimen. The ambulacra are not fully as straight as in the type, but less flexuous than in any other species excepting perhaps the otherwise very different *C. tribuloides* of the West Indies.

The interradia project beyond the ambulacra though not as much as in the Linnean type. The 5 has a breadth of 30 mm., and its open middle area is 8,5 mm. or 0,283. It is not as flat as in the *E. Cidaris*, the two halves faintly sloping against the suture, the upper, younger plates more so than the older plates below. In the 5 a the plate 7 measures 16,5 mm. and the scrobicule 9,5 or 0,575, while in the *Echinus Cidaris* the 5 a  $\beta$  measuring 20,9 mm. has a scrobicule of 11,2 mm. or 0,536, which is in conformity with the rule observed in the *C. papillata*, that the transverse inner diameter of the scrobicule is longer relatively to the length of the plate in younger than in mature specimens. The two uppermost scrobicules, 9 and 10, are circular, in the *E. Cidaris* the 11 and 12. As in that species the scrobicules are shallow, the verruculae of the ring small, the four upper and the four lower very minute, the lateral six or seven a little larger. A second outer row is diminished, and then follow not very distinct



transverse rows of very minute granules, diminutive at the suture. Within the calyx the costals are granulated, and the granules larger at the aboral margin and on the sides of the pore. This in the 1, of 6, 25 mm., is placed at 0,25 mm. from the adoral margin, which is at the outer 0,2 of the radial diameter, while in the 2, of 8, 3 mm., it is placed at 0,15. The corresponding measures in the *E. Cidaris* being 0,3 and 0,18, the rule observed in *C. papillata* is seen to hold good, and to point to the *C. baculosa* as a younger specimen, and the Linnæan type as an older one of one and the same species. The radials are triangular, truncated aborally, emarginated adorally, and their granules like those of the costals.

From this it will have been seen that the conformity between the type of the *Echinus Cidaris* L. and the *Cidaris baculosa* LAMCK. is such as to demand their being united under one and the same species name, while the differences are only such as mark different stages of individual development. The Linnæan type is a mature specimen of the

***Cidaris baculosa* LAMARCK.**

1752. *Echinus Cidaris* L. teste the MS. Lecture on the Vermes.  
 1816. *Cidarites baculosa* LAMCK., An. s. Vert., III, p. 55.  
 1826. AUDOUIN, Explic. somm. Descr. Égypte, p. 240; SAVIGNY, Echinod. t. 7, f. 1, 1—8.  
 1845. MICHELIN, Rev. Mag. Zool. Zooph. p. 16, t. 8.  
 1847. AGASSIZ, C. R. p. 23.  
 1866. v. MARTENS, Arch. f. Nat. XXXII, I, p. 144.  
 1872. AN. AGASSIZ, Rev. p. 150, 388, t. I, f. 4, 5; Ic. f. 34—38; Ie, f. 11—20 a.

1816. *Rhabdocidaris baculosa* LAMCK., 1883. DE LORIOI, Echinod. Maurice, p. 4, pl. 2, f. 2.
1816. *Cidarites pistillaris* LAMCK., An. s. Vert., III, p. 51.  
 » » » 1824. Enc. Méth., IV, p. 194, pl. 137.

For other references see AL. AGASSIZ' Revision. The *Cidaritis lima* VAL., AG. DES., seems doubtful on account of the primary verrucæ being said to be very large, and reminding of those of *C. imperialis*.

The works of preceding authors contained no figure agreeing with the type specimen of the *Echinus Cidaritis*, and LINNÆUS quoted only those nearest at hand that had a general resemblance to it, and afterwards, as years went on and when for a long time he had not seen the original, appended such others as came under his eyes and seemed to associate with it. The figure given by D'ARGENVILLE, of a species from the Red Sea, admits of no determination; GUALTIERI gives the *Cidaritis papillata* LESKE; that of RUMPHIUS, t. 13 fig. 3 possibly may have been meant for the *E. Cidaritis* L., and the spine *E* to the left has come from a *C. baculosa* LAMCK. The figure given by BONANNI probably is intended to represent the *C. papillata*, KLEIN'S t. 7 fig. *A*, by LOUIS AGASSIZ and DESOR transferred to the *C. tribuloides*, vaguely reminds us of that species as of the *C. parvispinis*-TENYSON-WOODS, while *B*, *C*, are rude figures of the *C. papillata*. Those of SEBA, t. 13 fig. 12, 13, are indeterminable, and those of BASTER, nearly so, are already cited under the *E. esculentus* and reappear here by mistake. The whole of these old figures, which in no way help to define the Linnean species or any other, may safely be consigned to oblivion.

Among other species the *Phyllacanthus gigantea* AL. AG. alone seems in some manner to come near to the Linnean type. A large specimen of it is said to possess ten primary interradial verrucæ, »the greatest number thus far noticed in any species of *Phyllacanthus* and *Cidaritis*«. The median interradial space covered with miliaries is more than half the total breadth of the interradium. The median ambulacral »zone« is crowded with miliaries forming eight or ten irregular vertical rows. The sexual pores are situated near the centre of the pieces. The specimen catalogued in the United States

National Museum as from Sandwich Islands, Townsend, (3554), diam. 77 mm., height 52 mm. or 0,675, kindly sent me for inspection by Professor RICH. RATHBUN, had eight tubercles in each interradial series. It seemed to be distinct by the different disposition of the secondary verrucæ in the ambulacral arcola, by its broader median interradial zone, and the very narrow marginal one, as by the lower form of the test. The accompanying spines were as described, — but the range of variation of these organs, and its causes, are yet to be more closely studied.

It would be fully legitimate to name the species described by LINNÆUS in 1752: *Cidaris Cidaris* L., were it not that its diagnosis, when about to be published for the first time in 1758, was altered, the most essential word: »globoso» of the primitive reading being exchanged for »hemisphærico», a term in no wise expressive of the form of the type specimen. Whereas the diagnosis in its first form fully served to distinguish the *Echinus Cidaris* from every other *Echinus* in the Queen's collection, in consequence of this alteration it not only excluded that species for which it was originally intended, but became insufficient to distinguish between different species within the whole genus in its present acceptance. The description would undoubtedly have cleared the question and removed any difficulty, but there is none in the M. L. U. To account for its absence it may perhaps be allowable to suppose that LINNÆUS, who in 1757 no longer had a vivid recollection of the original specimen and no hope of seeing it again, had before him at Upsala some other species of the genus and that the description drawn up at Drottningholm, when found not to answer, was sacrificed, while the diagnosis was adjusted to suit the other. Be this as it may, the species name: *Cidaris* L., left to its fate by the author himself, is to be laid aside as without validity, though of some historical interest.

As mentioned already there is in the Drottningholm collection a second specimen of a *Cidaris* not to be mistaken as having been the *E. Cidaris* L. They differ widely from one another and LINNÆUS surely never would have thought of uniting them. This second species is:

**Cidaris imperialis LAMCK.**

1816. Cidarites	imperialis	LAMCK.	An. s. vert. III, 54.
»	»	»	1837. DESMOULINS, Etudes, p. 318.
Cidaris	»	»	1830. BLAINV. Dict. Sc. n. LX, p. 212.
»	»	»	1834. ID. Man. d'Act. p. 231.
»	»	»	1847. AGASSIZ, C.R. p. 22.
1872. Phyllacanthus	»	»	AL. AG. Rev., p. 151, 391, t. Ie f. 1—6, spinæ, t. If. f. 2, non f. 6.
1883. Rhabdocidaris	»	»	DE LORIOI, Mém. Genève, XXVIII, No 8, II, t. I, f. 2.

TESTA hemisphærico-globosa, ambitu orbiculari, æqualiter convexa, vertice modice depresso, altitudine 0,73 diametri æquante.

CALYX suborbicularis granulatus; costalia leviter convexa, apertura sexuali aliquantulum extra medium sita.

AMBULACRA æqua, non immersa nec prominula, 7 mm. lata, flexuosa. Areola media planiuscula, dimidium æquans, assula quavis verruculam gerente primariam, marginalem, validiusculam; alteram proximam minorem deorsum persistentem, sursum denique evanidam; juxta ambitum solum ad suturam una alterne addita, minima.

INTERRADIA, 38 mm. lata, æqualiter convexa.

Verrucæ validæ, 6,5 vel 7 in quaque serie. Scrobiculi lati; supremi duo, sexti utriusque seriei, angulati et invicem contigui; priores transversim elliptici, verticaliter late et pressim contigui. Verruculæ circulorum superne et inferne minutæ, ad latera utrinque majores, validæ, numero quatuor vel quinque, scrobiculis præditæ lunatis, intus scil. recisis; extus verruculis minutis arcuatim cinctæ, una cum granulis suturæ appositis areolam tegentibus mediam angustam angulato-flexuosam, superne ad assulas sextas clausam, et lateralem utrinque angustissimam, fere nullam.

COLOR dilute rufo-fuscus, ambulacris et calyce saturate fusco-purpureis.

MENSURÆ: diameter 74 mm., altitudo 54 mm.

Two sub-adult specimens, one 50 mm. in diameter, 43 mm. in height, and with 5,5—6 verrucæ in the interradial series, and another 59 mm. and 37 mm., and the same number of verrucæ, with the same flexuous zones deeply coloured, as is also the calyx, and with the same disposition of the secondary verruculæ in the scrobicular rings, are in every respect similar, except that the ambulacral areola presents but two intermediary series of tertiary verruculæ, or four, of which the sutural two are very minute and alternating, and that the median areola of the interradia is still narrower, all in accordance with what has been seen in the *C. papillata*.

It has been remarked of this species, which it will be convenient, notwithstanding the vagueness of the original description, to constitute as the *Cidaris imperialis* LAMCK., that it is hardly distinguishable from the *Phyllacanthus dubia* of BRANDT<sup>1)</sup>. This author adopted the genus *Cidarites* LAMARCK, which comprised the two »groups»; »Turbans» and »Diademas». Of the former of these he made a »subgenus» called *Phyllacanthus*, which is nothing else than the genus ten years before<sup>2)</sup> named *Cidaris* by GRAY. The species, indeterminable from the description, which was drawn up not from nature, the specimens having been lost, but from an unpublished drawing, and for this very reason provided with that ill-omened name, never ought to have been admitted. The form in which AL. AGASSIZ with great doubts supposed to recognize it<sup>3)</sup> seems to be a semi-adult specimen of the *C. imperialis* LAMCK., of which his figure 2 represents a young specimen, with the interradial areola nearly closed. A different form, supposed by Australian naturalists to be the species had in view by BRANDT, has been sent me as a *C. dubia* by MR WILLIAM MACLEAY of Sydney, and of the same species another is in our old collection without a habitat. The former, 50 mm. in diameter and 36 mm. in height, with 6 or 6,5 verrucæ in each interradial series, has a broadly open interradial areola, equalling 0,14 of the interradius at the ambitus, and four granules in a row between the scrobicular circle and the suture, while the two series of circles close only with

1) *Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatorum*, I, p. 67; 1835.

2) *Annals of Philosophy*, X, p. 426; 1825.

3) *Revision*, Pl. If, fig. 6, 7,

their uppermost plates and near the peristome. In the other specimen, of 92 mm. and 61 mm. and with 7,5—8 tubercles, the areola attains in breadth to 0,18 of the interradium and presents up to nine granules in a row between the scrobicular circle and the suture, while marginally the rings are very near to the zones. Both specimens differ from the *C. imperialis* LAMCK., not only in these characters of the interradiial areola but also in the greater depth of the equally large scrobicules, with higher cones and smaller mamelons. The ambulacral areola is much the same; there are between the marginal tubercles two double rows of granules, the sutural one being alternating and disorderly. *Cidaris parvispinis* TENYSON-WOODS<sup>1)</sup> will be the name of this species.

The specimen of the *Cidaris imperialis* LAMCK., it seems to me most likely, had been added to the Drottningsholm collection after the short visit LINNÆUS made there in September 1754, when he drew up descriptions of two species of Echinoids then lately acquired. He could not have seen it by the side of his *E. Cidaris* without perceiving its distinctness. It may be presumed that it never came before his eyes. The species which afterwards caused him to alter the word »globoso» to »hemisphærico», was, I suppose, the *Cidaris papillata* LESKE which always was common in collections. The habitat, which in 1752 was the East-Indies, then, in 1758, became: the Ocean. That it was an inhabitant of a neighbouring sea was a fact LINNÆUS was not aware of until in November 1760 A. R. MARTIN brought him the specimens he introduced into the F. S. ed. 2, 1761, as *Echinus Cidaris*, with the same incomplete diagnosis as in the S. N. ed. 10, but referring solely, and rightly, to GUALTIERI, t. 108, fig. *D*, *E*. The habitat then became: »in Oceano Norvegico».

The two species which in the M. L. U. are the last among the »Regulares», as Nos 9 and 10, and a third species which in the S. N. ed. 10 appears as No 11, belong to the group of the Echinometræ, as indicated by the term: »ovalis».

<sup>1)</sup> Proc. Lin. Soc. N. S. W. IV. p. 286, Pl. XIV, fig. *A*, *B*. — RAMSAY, Catalogue of the Echinodermata in the Australian Museum, I, 1885. p. 3, 43. — JEFFREY BELL, Proc. Lin. Soc. N. S. W, IX, p. 503.

## 9. ECHINUS MAMILLATUS L.

ECHINUS hemisphærico-ovatus, ambulacris denis flexuosis, areis muricatis verrucosis: angustioribus abbreviatis.

## Prælectiones 1752.

*Guält. test. t. 108, f. C (B).*

*Argenv. conch. t. 28, f. E.*

## M. L. U. 1764, add.

*Rumph. mus. 82, t. 13, f. 1.* Echinometra digitata l. oblonga.

## S. N. ed. 10, 1758 add.

*Klein, Echinod. 19 t. 6 (ed. germ.)* Cidaris mamillata Pauli.

## S. N. ed. 12 subst.

*Klein, Echinod. 19 (ed. german.), t. 3, f. A (ed. gall.)*

## S. N. ed. 10 et 12.

*Habitat . . . .*

The description in the M. L. U. is utterly at variance with the diagnosis and evidently not intended for this species. It is consequently omitted here and will be discussed under the next.

In the original set of Echinoids in the Queen's Cabinet first described by LINNÆUS this was the last among the Regulares, and so it was in the Lectures of the autumn of 1752. The diagnosis then ended with the word: »verrucosis». The following two words in the S. N. ed. 10: »angustioribus abbreviatis» were added to distinguish it from the No 10, which had been acquired in the mean time. They refer to the well-known peculiarity of its ambulacral tubercles which increase in size from the peristome to the ambitus and above it, but then suddenly become very small. It was named E. mamillatus in the S. N. ed. 10, and has been ever since universally

known under that name. The collection contains no specimen referable to it, and its printed label of 1790 has been given to the *E. diadema*, showing that the typical specimen had then already disappeared.

The figure in RUMPHIUS, t. 13, f. 1 doubtless represents the *E. mamillatus*, but was not referred to in the Lecture of 1752 because not at hand, while the two following were quoted. GUALTIERI f. *C* is a mistake for f. *B*, for that time a good representation. D'ARGENVILLE, t. 28, f. E, is the *Diadema saxatile* L. In the S. N. ed. 10, 1758, is added, rightly, KLEIN (German ed.), p. 19, t. 6, for which in the ed. 12 has been substituted, from the French edition, t. 3 f. A.

Out of this species and two more BRANDT<sup>1)</sup> made a »subgenus» called *Heterocentrotus*, a name that GRAY<sup>2)</sup> and JOHANNES MÜLLER<sup>3)</sup> many years ago proposed to shorten to *Heterocentrus*. The ninth Linnean species then becomes:

### *Heterocentrus mamillatus* L.

RUMPH. Amb., p. 32, t. 13, f. 1, 2, orig., 1705. — KLEIN, Dispos., p. 19, *Cidaris mamillata*, species 1, Mamillæ Sancti Pauli Melitensium, t. VI, orig., 1734. — ID. ed. gall. t. 3, fig. A, B, 1754. — SCHYNVOET, Thes. imag., t. 13, f. 1, 2, repet. Rumph., 1739. — GUALTIERI, Test. t. 108, f. B, orig., 1742. — SCILLA, de corporibus marinis, ed. 2, 1752, t. XI, No 1, fig. 2, orig., 1752. — SEBA, Thes., III. p. 27, t. 13, f. 1, 2, orig., 1758. — Recueil de planches sur les sciences, du Dictionnaire de l'Encyclopédie, fol., t. 60, f. 2, orig., 1768. — D'ARGENVILLE, Conchil., éd. 3, FAVANNES, III, t. 56, f. D, 1, orig., 1780.

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|-------|------------------------------|--|
| 1758. | <i>Echinus mamillatus</i> L. | S. N. ed. 10, p. 664.  |
| »     | »                            | » 1764. M. L. U. p. 711.   |
| »     | »                            | » 1767. S. N. ed. 12, p. 1103.   |
| »     | »                            | » 1770. HOUTTUYN, Natuurlyke Hist., XIV, p. 513, t. 114, f. 3, 4 orig.           |
| »     | »                            | » 1775. STAT. MÜLLER, Natur-Syst., VI, 1, p. 151, t. 8, f. 3, 4, imit. Houttuyn. |

1) Prodr. Descr. Anim., p. 63.

2) Synopsis Brit. Mus., ed. 43, 1841, p. 137.

3) Ueb. d. Bau d. Echinodermen, Berl. Abh., 1853, sep. p. 8.



1758.	Echinus	mamillatus L.	1777.	KNORR, Delic., p. 79, t. D, f. 3, orig.
	»	»	1787.	HERBST, Eink. Würm., I, t. 23 A, 395, f. 2, imit. Rumph.
	»	»	1816.	LAMARCK, An. s. vert. III, p. 51.
	»	»	1825.	BLAINVILLE, Dict. sc. nat., XXXVII, p. 97.
	»	»	1827.	Enc. méth. t. 138, f. 1, 2, imit. Sebæ, 3, 4, imit. Klein.
	»	»	1830.	CUVIER, R. A. éd. ill., Zooph., t. 13, f. 1, orig.
	Cidaris	»	1778.	LESKE, Add., p. 121, t. VI, rep. Klein; t. XXXIX, f. 1, imit. Seba.
	Echinometra	»	1825.	GRAY, Ann. Phil., X, p. 423.
	»	»	1830.	BLAINV. l. c. LX, p. 206.
	»	»	1834.	Id. Man. d'Actin. p. 227.
	»	»	1837.	DESMOULINS, Etudes, p. 264.
	Heterocentrotus	»	1835.	BRANDT, Prodr. descr. an. p. 66.
	»	»	1872.	AL. AGASSIZ, Rev. p. 133, 428, t. III c, orig.
	»	»	1883.	De LORIOI, Echino- dermes du Maurice, p. 35.
	Acrocladia	»	1846.	LOUIS AGASSIZ, C. R. p. 70.

For other names and synonyms see AL. AGASSIZ' Revision l. c.

10. ECHINUS LUCUNTER L.

ECHINUS hemisphærico ovatus, ambulacris denis flexuosis, areis muricatis: angustioribus longitudinalibus.

S. N. ed. 10.

*Gualtieri, test., t. 107, f. C.*

M. L. U. add.

*Seba, Mus., III, t. 11, f. 11.*

S. N. ed. 12 add.

*Klein, Echinod. t. 2. f. C. (ed. gall.)*

S. N. ed. 10 et 12.

*Habitat in O. Indico.*

**Descriptio sequens, in M. L. U. sub E. mamillato perperam data, hic inseritur:**

TESTA E. Diademati simillima, vix distinguenda; a qua differt

Verrucis quadruplo minoribus, glabris, basi planiusculis.

AMBULACRA subtus oblique repanda, punctis intercepta.

AREOLÆ angustiores tuberculis longitudinalibus, æqualibus margini.

Alba colore minusque fusca.

This species is not in the Lecture of the autumn 1752; it was a later addition to the Queen's Cabinet. According to the diagnosis it is distinguished from the *E. mamillatus* by the character of the interradial verrucæ which, instead of suddenly diminishing above the ambitus: »areis angustioribus abbreviatis», form regular, longitudinally continuous rows: »areis

angustioribus longitudinalibus». And just as in virtue of the former phrase alone tradition was led to recognise the *E. mamillatus*, thus by the two last words it has been guided to select, as the type LINNÆUS had in view, the species widely distributed in the Atlantic within the tropics from Florida and the Cape Verde Islands to St Helena, and of old very common in collections, which furnished SEBA with his originals from the island of St. Thomas on the west coast of Africa, was recognised by LESKE, and was at last established by LÜTKEN under the Linnean name. And this was doubtless correct. The collection from Drottningholm contains of the genus *Echinometra* only two specimens, both of which belong to this well-known West Indian form, described by authors under various names, by LINNÆUS as *E. Lucunter*. One of them is of the common variety, the other of the broader one, and like the *Heliocidaris mexicana* AGASS.

The M. L. U. has no description of this species. My reasons for transferring to it the description given there under the *E. mamillatus*, have been the following:

When in 1752 LINNÆUS described the Echinoids then present in the Queen's Museum, he had only very exceptionally begun to apply the binary nomenclature foreshadowed in the *Philosophia Botanica*, and there is no trace of it in the Lectures on the genus *Echinus* delivered shortly afterwards. Consequently it is scarcely probable that the words: »*E. Diademati simillima*» can have been originally written under the »nomen specificum» of the *E. mamillatus*. Now, before the introduction of the binary nomenclature, whenever it was required for comparison's sake to refer to some other species, this was done either by means of repeating wholly or in part its »nomen specificum», or by indicating its place in the series, for instance through the word: »*præcedenti*». If it be remembered also, that in the MS of the entomological part of the M. L. U. the description of an additional species is sometimes found written by LINNÆUS on the back of a schedule already inscribed with an allied species, it seems allowable to suppose that, having written down on the back of the No 9: *E. mamillatus*, the diagnosis of the No 10: *E. Lucunter*, he added its description beginning with: »*T. præcedenti*» (i. e. *Echino mamillato*) »*simillima*». The copyist of 1764, however, it may be further supposed, in his hurry inadvertently turned the schedule, then

placed the description of the No 10 under the No 9, and at the same time took care, by way of emendation, to alter the beginning word: »præcedenti» into »E. diademati», the trivial name then newly given to the No 8.

The absurd comparison with the *E. Diadema*, which was in this way, I suspect, smuggled in, could not but throw irremediable confusion over the whole description, destined as this was, not to elucidate the characters of the *E. mamillatus*, but, as will be seen, to point out their very contrasts. For all comes right when the description under the No 9 in the *M. L. U.* is transferred to the No 10, and its first words restored to: *T. præcedenti simillima*. Then it is found that LINNÆUS says of the *E. Lucunter*: that it is very like the *E. mamillatus*, but distinguished by its verrucæ which are »quadruply smaller», — the areæ of their scrobicular circles are respectively as 1 to 3,24 — and have their »basis», that is the rather broad scrobicula, to a great extent nearly flat and not rising conically directly from the circle as in that species. Furthermore, he says, the »ambulacra», that is the poriferous zones, on the under side have their pores disposed in such a manner as to form a repand or slightly sinuous outline<sup>1)</sup>, and to be intercepted between »puncta», that is minute secondary verruculæ. He then once more insists on the character of the »tubercles» of the areolæ being »longitudinal», that is: arranged in rows continuous from the peristome to the top, and regularly bordering upon the zonæ, the very opposite of what is seen in the *E. mamillatus*, whose rows of ambulacral tubercles are abridged: consisting of true verrucæ from the peristome to above the ambitus, but then of a sudden reduced to verruculæ. Lastly he states that the colour is white, presenting hardly a trace of the brown tinges of the *E. mamillatus*, which strikingly illustrates the colouring of either species as they generally occur in old collections.

It is seen how nicely the characters of the *E. Lucunter* are indicated, so pointedly indeed as almost to permit us to reconstrue, by contrast, the lost description of the *E. mamillatus*. How this came to disappear perhaps not even the careless copyist himself was able to explain.

<sup>1)</sup> *Philosophia botanica*, p. 42, folium repandum, fig. 29. Compare also my *Etudes*, t. XVIII. fig. 157.

The Indian Ocean is given as the habitat of this species, no doubt by a mistake consequent on the interchange of descriptions. Thirteen out of the fourteen species forming the original set of Echinoids in the Queen's cabinet were from the seas of the Old World, mostly from the East Indies. Of later additions two are the commonest of West Indian species, and one of them is the *Echinus Lucunter* L. It may be taken for granted that these were in the collection presented to the Queen in 1754 by Colonel C. G. DAHLBERG, which contained »some things from the West Indies»<sup>1)</sup>, and that LINNÆUS described them when at Drottningholm during the last days of September in that year.

In the S. N. ed. 10 reference is made to one figure only, that given by GUALTIERI, t. 107, f. C, which is too rude to be admitted. The M. L. U. adds SEBA, III, t. 11, f. 11, which seems acceptable. Lastly the S. N. ed. 12 subjoins KLEIN, ed. gall., t. 2, f. C. This was intended for a repetition of KLEIN, ed. german., t. IV f. A, which together with f. B tolerably well represents a middle-sized specimen of *Colobocentrus atratus* L. But the French engraver had neglected reversing his original, and thus disguised it. — To his f. C, D on t. III, which are passable figures of the *E. lucunter* L., KLEIN gives the name: »*Cidaris variolata*, § 7, Species III, d'Acqueti, Türksche Tulband»<sup>2)</sup>, an evident error already remarked by LESKE. But this author, who never saw the collection he commented on, but searched other collections for specimens that seemed to him to agree with the figures of KLEIN, in this instance pitched upon a species in the cabinet of TRIER, widely different alike from the »oblongo-teres» of SEBA and the »Tulband» of SCHYNVOET, and described it as *Cidaris subangularis*: »Ambitus orbicularis, forma fere hemisphærica, tæniæ poris per quatuor s. quinque paria arcuatis» e. s. p. This being so, the name »subangularis», adopted, though not without hesitation, by DESMOULINS<sup>3)</sup> is to be discarded.

<sup>1)</sup> L. to Bäck, 25/8 54.

<sup>2)</sup> Dispositio, p. 18.

<sup>3)</sup> Etudes, p. 266.

**Echinometra Lucunter L.**

KLEIN, Dispos. t. III, f. *C. D.*, orig. 1734. — ID. ed. gall. t. II, f. *B.*, imit. non reversa KLEIN. 1754. — SEBA, Thesaur., III, p. 20, t. 10, f. 16, 17, 18, ex ora Guineensi Africæ, insula S:ti Thomæ; p. 25, t. 11, f. 11, *Echinus saxatilis oblongo teres, Africanus*; orig. 1758.

- |       |                    |                 |    |   |
|-------|--------------------|-----------------|----|---|
| 1758. | <i>Echinus</i>     | <i>lucunter</i> | L. | S. N. ed. 10, p. 665.   |
|       | »                  | »               | »  | 1764. M. L. U. p. 711.  |
|       | »                  | »               | »  | 1767. S. N. ed. 12, p. 1103.  |
|       | »                  | »               | »  | 1825. SAY, Journ. Ac. Nat. Sc. Philadelphia, V, p. 226.                           |
|       | <i>Cidaris</i>     | »               | »  | 1778. LESKE, Add. p. 109, descr., vix vero t. IV, f. <i>C. D.</i> , repet. Klein. |
|       | <i>Echinometra</i> | »               | »  | 1863. LÜTKEN, Bidrag till Kundskab om Echiniderne, Vid. Meddelelser p. 18.        |
1847. *Heliocidaris mexicana* AGASS. Cat. R. 68.  
 1872. *Echinometra subangularis* AL. AG. Rev. p. 116, 283, non LESKE.

## 11. ECHINUS ATRATUS L.

ECHINUS hemisphærico-ovalis depressiusculus: spinis truncatis brevissimis obtusissimis: marginalibus clavatis depressis.

S. N. ed. 12.

*Rumph. Mus. t. 13 f. 2.*

*Klein Echin. t. 23. (ed. gall.)*

*Seba Mus. III, t. 13. f. 4.*

*Habitat in India; e Museo Tessiniano.*

Spinæ brevissimæ, obtusissimæ, subcontiguæ tegunt testam; sed marginales elongatæ, læves, depressæ.

This species, of which a denuded specimen was figured by KLEIN in 1734, was first known with its spines preserved by the delineation given in 1754 in the appendix to the French translation of his work, representing a specimen from the Mauritius in RÉAUMUR'S Cabinet. It is not mentioned in the Museum Tessinianum published in 1753, nor in the M. L. U. of 1764, but among the Echini from Drottningholm there is a specimen without spines, probably acquired after that time. The specimen described by LINNÆUS is in Copenhagen, with other parts of Count TESSIN'S collections.

The figures quoted from RUMPHIUS, representing the *Heterocentrus mamillatus*, and from SEBA, *H. trigonarius*, both probably from recollection only, are to be excluded.

### Colobocentrus atratus L.

KLEIN, Dispos., p. 18, *Cidaris variolata*, sp. IV, *Ellyptica*,  $\alpha$ , t. IV, f. A., B., orig., 1734. — KLEIN, *Ordre Naturel*, p. 225, t. 23, orig. 1754. — BRANDER, *Phil. Trans.* XLIX, p. 295, t. 8, f. 3, orig., 1755. — D'ARGENVILLE, *Conch.*, ed. 2, t. 25, f. G, orig., 1757. — *Recueil de planches du Dictionnaire de l'Encyclopédie*, t. 61, f. 2, orig., 1768. — D'ARGENVILLE *Conch.* ed. 3, FAVANNES, t. 56, f. H. H. orig., 1780. — *Voyage de LA PEYROUSE*, Atlas, pl. 27, 1, editio gall. fig. 1-10, orig.

- |                        |         |         |  |
|------------------------|---------|---------|--|
| 1758. Echinus          | atratus | L.      | S. N. ed. 10, p. 665.  |
| »                      | »       | »       | 1767. S. N. ed. 12, p. 1103.   |
| »                      | »       | »       | 1770. HOUTTUYN, Natuurl. Hist. XIV, p. 519, t. 114, f. 5, orig.                  |
| »                      | »       | »       | 1780. ST. MÜLLER, Nat.-syst., VI, p. 152, t. 8, f. 5, imit. Houtt.               |
| »                      | »       | »       | 1816. LAMARCK, An. s. v. VI, p. 51.  |
| »                      | »       | »       | 1825. BLAINVILLE, Dict. sc. nat. XXXVII, p. 96.                                  |
| »                      | »       | »       | 1827. BORY, Enc. méth. t. 140, f. 1, 2, imit. Klein ed. germ.; f. 3, 4 ed. gall. |
| »                      | »       | »       | 1830. CUVIER, R. A. éd. ill. t. 13, f. 2, orig.                                  |
| Echinometra            | »       | »       | 1825. GRAY, Ann. Phil. X, p. 427.  |
| »                      | »       | »       | 1830. BLAINVILLE, Dict. sc. n., LX, p. 206.                                      |
| »                      | »       | »       | 1834. ID. Man. d'Act., p. 225, t. 20, f. 1, orig.                                |
| »                      | »       | »       | 1837. DESMOUL., Etudes, p. 262   |
| Colobocentrotus        | »       | »       | 1835. BRANDT, Prodr. Descr. An. p. 67.   |
| »                      | »       | »       | 1847. AGASS. et DES., C. R. p. 70.   |
| »                      | »       | »       | 1873. AL. AGASSIZ, Rev., p. 102, 424, t. III d, f. 3, orig.                      |
| 1778. Cidaris violacea | LESKE,  | Addit., | p. 117, 119, t. 47, f. 1, 2, imit. Klein gall.                                   |

Other synonyms are seen in AL. AGASSIZ, l. c.

LESKE confers the appellation of *Cidaris fenestrata* on KLEIN, t. IV, f. A, B, but describes an entirely different species from the Trier collection: »ambitu omnino orbiculari, . . . pori paribus ternis in ordinibus parum obliquis fere transversis positi» . . . Consequently the name must disappear. He knew, p. 119, that the species figured in KLEIN, ed. gall., was the *E. atratus* L., but nevertheless coined a new name for it.



\*\* *Irregulares apertura ani subtus uti os.*

12. ECHINUS SPATAGUS L.

Tab. 6, fig. 1.

ECHINUS ovatus gibbus: ambulacris quaternis depressis.

Prælectiones 1752.

Gualtieri, t. 109 f. A.

Rumph., t. 14 f. B. (1.)

Sloane, t. 241, f. 3, 4, 5.

D'Argenville, t. 28 f. M.

S. N. ed. 10, 1758; M. L. U. 1764.

F. S. ed. 1746, N:o 1290.

Rondelet, *Exsangu.* p. 580, gall. 416.

Bonanni, *Recr.* I, t. 16.

Lister, *Appendix*, p. 28.

S. N. ed. 12, 1767.

Imperati, *nat.* p. 910, 911.

Klein, *Echinod.* t. 28 (ed. gall.)

Ginanni, *Adriat.* II, p. 41, t. 29, f. 174.

S. N. ed. 10 et 12.

*Habitat in Oceano omni.*

TESTA ovata, convexa instar pomi.

*Supra* adpersa punctis eminentibus et striis reticulatis.

Centrum versus anteriora, ex punctis 4 perforatis: quorum 2 posteriora majora.

Radii 4 a centro diducti, lanceolati, obtusi, concavi, ex seriebus 4 punctorum perforatum.

Quintus radius versus anteriora obsoletus.

*Subtus* superficie similis superiori.

Centrum reniforme perforatum magnum, sub centro superiore.

Foramen ovatum postice in obtusissima parte.

Puncta tria gibbosa in postica parte.

Area pone hanc gibbositatem radiata et 4 utrinque punctis notata.

Misled by the reversed figure in GUALTIERI and not undeceived by the one transversely placed in RUMPHIUS, LINNÆUS fell into the error of inverting the specimen he described, taking the forepart for the hinder part, and the anal end for the front one. In order therefore rightly to understand the description, which but for this one mistake would be excellent for that time, it becomes necessary to read »posteriora», »postice», »pone», for »anteriora», »antice», »ante», and »anteriora», »antica», »antice» for »posteriora», »postica», »postice». This correction has been applied to the Linnean description given above.

Thus, the dorsal »centrum» is anterior. Of the four sexual apertures the two posterior are the larger. The frontal ambulacrum, »radius quintus», is not really wanting, but obsolete. The reniform mouth is anterior, right under the apex; the excretory opening at the posterior blunted extremity. Upon the hind part of the ventral surface there are three prominences from which the tubercles radiate: one on the sternum itself, close to its posterior margin, a second on the episternum, and a third on the first pair of pre-anal plates. Behind these prominences, or, rather, behind the first two of them, there is an area circumscribed by the sub-anal fasciola, and within that area the radiating disposition of the tubercles is very distinct; and on each side there are four pedicellar pores.

From this description the species has been made out to be one of the Brissinæ. There are three specimens of *Spatangi* in the collection, namely two of the *Brissus columbaris* LAMCK., and one of the *Metalia maculosa* LESKE. On this specimen there is pasted a Swartzian printed label: *Echinus Spatagus*, and near it there is lying a small strip with the same name in THUNBERG'S hand. It is entirely denuded, with the large periproct deprived of its anal membrane and gaping, and accords with this entry in THUNBERG'S list: »*Echinus Spatagus* . . . . without spines, entire, with a hole in it», meaning the open periproct. That this specimen alone, the single one of the *Metalia maculosa* LESKE, is the type described by LINNÆUS, is shown already by the words: »striis reticulatis», referring to the reticulated lines of a lighter colour marking the sutures, and which in this species are often particularly distinct, and were laid stress upon in the descriptions and delineations of the time, as the »nitida, marmoris veluti,

variegatio» of SEBA<sup>1)</sup>, or by the epithet »gemarmerde», used by SCHYNVOET when he inserted into RUMPHIUS the figure of a specimen from D'ACQUET'S collection.

The four petals, I, II, IV, V, the »radii», are described as: obtuse, a term LINNÆUS would not have used of the long and pointed ones in *Brissus columbaris*. The »puncta gibbosa», on the sternum and the episternum, generally of characteristic distinctness in the genus *Metalia*, are much more prominent than in the *Br. columbaris* or any other species of *Brissus*, and the number of sub-anal pedicellar pores is four on each side, while in the specimens of *Br. columbaris* it is five. Lastly, it is worth remarking that while the anal membrane is lost in the specimen of *Metalia maculosa*, as expressly stated: »foramen ovatum in obtusissima parte» — »a hole in it» THUNBERG —, it is preserved and intact in both specimens of *Brissus columbaris*, a circumstance which LINNÆUS hardly would have passed over, as it was of very rare occurrence in the collections of his time. Of these two *Brissi*, also, one has its spines to a great extent preserved, the other for a small part only, all of which makes it probable that they had not, like the *Metalia*, belonged to the original Dutch set of specimens in the Queen's Museum, which were all from the seas of the Old World, and all of them »cleansed» by cooking, as was then the custom. And, moreover, importation from Holland is attested by a slip of paper stuck into the *Metalia* through the large gaping periproctal aperture, and bearing the words: »Het Moloch», no doubt its Dutch »*nom de guerre*».

### *Metalia Spatagus* L.

RUMPHIUS, t. XIV, f. 1, orig. 1705. — KLEIN, Disp. p. 36, *Brissus* Spec. I, *maculosus*,  $\alpha$ ) *angustus*, t. XXIV, f. A, B;  $\beta$ ) *ventricosus*, t. XXVI, f. A.; Spec. II, *unicolor*, t. XXVI f. B, C. orig., 1734. — Id. ed. gall. p. 107, t. XIII, f. D; XIV, f. B; XV f. A, repet. Klein, 1754. — GUALTIERI, t. 109, f. A. A., orig. 1742. — SEBA, III, p. 22, t. X, f. 22, a, b. orig. 1759.

1758. *Echinus Spatagus* L. S. N. ed. 10, p. 665.

» » » 1764. M. L. U., p. 712.

<sup>1)</sup> Mus., III, p. 22, t. X f. 22.

1758. Echinus Spatagus L. 1767. S. N. ed. 12, p. 1104.  
 » » » 1778. LESKE, Add. p. 246.  
 1778. Brissus maculosus LESKE, Add. p. 247.  
 » » » 1866. v. MARTENS, Wiegman.  
 Arch., XXXII, p. 181.  
 Metalia » » 1872. AL. AG. Rev., p. 144,  
 598, t. XXIIb, f. 8, 9.  
 » » » 1883. DE LORIOU, Mém. Ge-  
 nève, XXVIII, No 8,  
 p. 46.  
 1778. Brissus unicolor LESKE, Add. p. 248.  
 Spatagus » » 1830. BLAINV. Dict. Sc. Nat.,  
 LX, p. 184.  
 » » » 1834. ID. Man. d'Act. p. 203.  
 » » » 1837. DESMOUL. Et., p. 382.  
 1816. Spatangus ovatus LAMCK., Hist. an. s. v., III, p. 30.  
 » » » 1827. BLAINV., Dict., L, p. 89.

In the Lecture of 1752 LINNÆUS referred in the first place to GUALTIERI and RUMPHIUS, both of which give figures of the *Metalia maculosa* LESKE, and, next, to SLOANE who figures small specimens of the *Brissus columbaris* LAMCK.; to these in the S. N. of 1767 was added the woodcut in IMPERATI, of the *Brissus Scillæ* AGASS. The rest of the references belong to the *Schizaster canaliferus* LAMCK., and the *Echinocardium cordatum* PENN., and will be considered under the next species.

We may be permitted to conjecture that when LINNÆUS in September 1754 saw the three West Indian Echinoids that had been lately added to the collection, he at once recognised as new and described the two: the *E. lucunter* from comparison with the *E. mamillatus*, and the *E. reticulatus* from comparison with the *E. rosaceus*, but found himself unable to decide about the third, now our *Brissus columbaris*, because the original of his *E. lacunosus*, a fragile species, was already lost and could not be compared. It cannot be wondered at that SWARTZ, who found it missing in 1790, did not know what to do with the two specimens of the *Brissus columbaris*, whose characters were not those of either of the two *Spatangidæ* in the M. L. U. And thus it happened that the one of them, which is almost completely denuded and answers to the words in THUNBERG'S list: »*E. Spatagus* . . . without spi-

nes, broken», bears a Swartzian label: *Echinus Spatagus*, while the other, which has retained a great part of its spines, two thirds or so, and is entire, has lying near it a printed label: »*Echinus lacunosus*» and a slip with that name in THUNBERG'S hand. It answers to this entry in his list: »*E. lacunosus*, 1 specimen, with spines». SWARTZ had solved the puzzle by bestowing two different Linnean names on a third species, and THUNBERG simply followed him.

The original *Echinus Spatagus* L., obscured as it had become by a variety of additional quotations, was duly recognised by LESKE<sup>1)</sup>, who, nevertheless, named it afresh »*maculosus*». Of the »genus» *Brissus* KLEIN had *l. c.* two »species», which he distinguished by their mode of colouring: »I, *maculosus*»  $\alpha$ ) »*angustus*»,  $\beta$ ) »*ventricosus*», and »II, *unicolor*». Of the I,  $\alpha$ , LESKE<sup>2)</sup> gives a tolerably exact description, referring, rightly, to RUMPHIUS, SEBA t. X, f. 22, and GUALTIERI, and, erroneously, to IMPERATI and SCILLA, who give *Brissus Scillæ*, and to SEBA, t. X f. 19, which represents *Br. columbaris*. He remarks that KLEIN'S »II, *Brissus unicolor*», is very closely related, but erroneously adduces SLOANE'S figure of *Brissus columbaris*. A specimen from Zanzibar now before me perfectly agrees with the »*unicolor*» of KLEIN, and shows no difference whatever from the Linnean type-specimen of *E. Spatagus* except that it is all of one greyish brown colour. But it differs very widely from the two forms here following with which it has been associated:

### *Brissus Scillæ* Ag.

IMPERATI, *Hist. naturalis, Libri XXIIIX, ex italica in linguam conversa latinam, Coloniae, p. 907: Echinus gladius nudus figura oblonga; p. 910: Echinus gladius vestitus, fig. orig., 1695. — SCILLA, de corp. marinis, ed. alt., t. IV, f. 2, 3, orig., 1752.*

1836.	<i>Brissus</i>	<i>Scillæ</i>	Ag.	Mém. Neufch. I, p. 185.
»	»	»	»	1847. AG. & DES. C. R., p. 119, t. 16, f. 9.
»	»	»	»	1852. FORBES, <i>Foss. Echin. Brit. Tert.</i> , p. 15, t. 2, f. 4.

<sup>1)</sup> Addit. p. 246.

<sup>2)</sup> *Ib.*, p. 247.

1856. *Brissus Scillæ* AG. 1855. GRAY, Catalogue I, p. 53.  
 » » » 1856. FORBES, Brit. Org. Rem., Dec. V, t. 10.
1841. *Spatangus ventricosus* (*non* LAMCK.) DELLE CHIAJE, Descr. e not. An. inv., IV, p. 32, 52, t. 123.
1845. *Brissus placenta* PHIL., Wieg. Arch. XI, 349.  
 Hab. Mare Atlanticum, prope oras orbis antiqui, et Mare Mediterraneum.

***Brissus columbaris* LAMCK.**

SLOANE, Nat. Hist. Jamaica, t. 242, f. 3, 4, 5, orig., 1725. —  
 SEBA, Thes. t. X, f. 19, a, b, orig., 1758.

1816. *Spatangus columbaris* LAMCK., An. s. vert., III, p. 30.  
 » » » 1827. BLAINV., Dict. sc. nat. L, p. 89.  
 » » » 1827. Enc. Méth. t. 158, f. 9, 10, imit. Sebæ.  
 » » » 1830. BLV. l. c. LX, p. 184.  
 » » » 1834. Id. Man. d'Act. p. 203.  
 » » » 1837. DESMOUL., Et. p. 384.  
*Brissus* » » 1825. GRAY, Ann. Phil. X, p. 431.  
 » » » 1847. AG. DES., C. R. p. 119.  
 » » » 1855. GRAY, Catal. p. 54, t. 6, f. 3 orig.  
 » » » 1863. LÜTKEN, Meddel., p. 118.

Hab. Mare Caribbicum.

These two forms come very near to each other and have been, I believe, rightly united into one species. But from the »unicolor» of KLEIN, the *E. Spatagus* L., they deviate *toto celo*. Not only is the general form another, more lengthened posteriorly, the back keeled, the petals, particularly in the Br.

Scillæ, narrower, lanceolate, sub-linear, not obtuse, but there is also a great dissimilarity in the characters of the sternum, which, in either of them, as in the *Brissus carinatus* LAMCK., and particularly in the *Br. columbaris*, is very broad, in a relation of 72 to 100 to the entire breadth of the body, but slightly convex, not keeled, nearly without distinct eminences, whereas in the «unicolor» it is narrow, as 30 to 100, and keeled, and shows very distinctly the prominent centres of tubercular radiation. The sub-anal fasciola, decidedly reniform in the *Brissus columbaris* and the *Br. Scillæ*, and deeply bent in under the periproct, is cordiform in the *Br. unicolor* of KLEIN, arcuated under the periproct, and sends off, on each side, an ascending branch reaching as high as to its dorsal margin, as exhibited even in the figure *B* of KLEIN, a character adopted as distinctive for the genus *Metalia*. Consequently it becomes an impossibility to unite into one species the *Brissus unicolor* of KLEIN, the *Brissus columbaris* LAMCK., and the *B. Scillæ* AG.

LAMARCK described a *Spatangus compressus* from the Mauritius, and from that island, as well as from Zanzibar, there comes a form that answers well to his description, and was, happily, recognised by v. MARTENS<sup>1)</sup>. It is a true *Brissus*, and not at all like the *Metalia maculosa*. It is elliptic, the petals are broader than in specimens of a corresponding size of the *Br. carinatus*, *Scillæ*, or *columbaris*; the II and IV are directed very slightly backward and have their points a little bent forward; I and V diverge a little and are very faintly sigmoidal; their length is to that of II and IV, as 100: 72. The sternum is broad, the subanal area reniform, with five pedicellar pores on the left and four on the right. The peripetalous fasciola has two re-entering angles on the interradia 2 and 3. It is evident that this species cannot by any means be identified with the *Metalia Spatagus* L.

<sup>1)</sup> Arch. f. Naturg., XXXII, 1866, I, p. 183.

13. ECHINUS LACUNOSUS L.

ECHINUS ovatus gibbus, ambulacris quinis depressis.

Prælectiones 1752.

*Fauna Suecica ed. 1746, sp. 1290.*

S. N. ed. 10, 1758, et M. L. U., 1764.

*Rumph. mus. t. 14, f. 2.*

*Gualt. test. t. 109, f. C.*

*Breyn. Echin. p. 61, t. 5, f. 1, 2.*

S. N. ed. 12, 1767, add.

*Klein. echin. t. 14, B et t. 13 f. C. (ed. gall.)*

S. N. ed. 10, 1758, et ed. 12, 1767.

*Habitat in Indico.*

TESTA ovata, convexa.

*Supra* adspersa lineis exoletis, reticulatis, gibba.

Centrum ex punctis duobus perforatis.

Radii 4 obtusi, depressi: punctis quatuor ordinum, horum radii duo anteriores longiores.

Fossa concava inter centrum et apicem s. inter radios majores, profunde lateribus punctata, striata.

*Subtus* testa, uti a pagina superiore.

The MS Lecture adds: »The front area is more deeply impressed than the others, like a channel, whence the species is called lacunosus».

The type of this species appears to have been lost very early, and in 1790 SWARTZ bestowed its printed label on specimens of a generically different species never described by LINNÆUS.

The description in the M. L. U. is such as to leave no doubt whatever about the modern genus to which its original



is to be referred. It is evidently a *Schizaster* AG., and one of the group characterised by only two sexual pores. Attaching due weight to the word »ovatus», which excludes the *Sch. ventricosus* GRAY<sup>1)</sup>, and setting aside the *Sch. Jukesi* GRAY<sup>2)</sup> which greatly needs reconsideration, we are left to choose between the *Sch. canaliferus* LAMCK. of the Mediterranean, and the *Sch. japonicus* AL. AGASSIZ<sup>3)</sup> of the seas of Eastern Asia, from Japan to the Arafura and Java Seas. Both species used to be represented in the Museums of the time, the former in those of Italy, as attested by ALDROVANDI, IMPERATI, GUALTIERI, BONANNI, the latter in those of Holland. The rude figure in the »Rariteit-kammer», which cannot well be taken for anything else, was drawn from a specimen contributed by D'ACQUET who probably had it from the author. HOUTTUYN, who took some pains to make out the Linnæan Echini, had a figure made, as good as any in modern works generally, which evidently represents the *Sch. japonicus*; he adds that the original was believed to have come from the East Indies. The specimen described by LINNÆUS made part of the Dutch set of 1751, and it can scarcely be doubted that, like the rest of those thirteen species, it was assumed to have come from some Dutch settlement in the tropical parts of the Old World, and accordingly was marked: Habitat in Oceano Indico. Thus the *Echinus lacunosus* becomes:

### *Schizaster lacunosus* L.

RUMPH. Amb. p. 36, t. XIV, fig. 2.

- |       |                             |  |
|-------|-----------------------------|--|
| 1758. | <i>Echinus lacunosus</i> L. | S. N. ed. 10, I, p. 665.   |
| »     | »                           | » 1764. M. L. U. p. 713.   |
| »     | »                           | » 1767. S. N. ed. 12, p. 1104.   |
| »     | »                           | » 1770. HOUTTUYN, Nat. Hist., XIV, p. 522, t. 114, f. 6, orig.             |
| »     | »                           | » 1775. STAT. MUELLER, Nat. Syst., VI, p. 153, t. 8, f. 6, imit. Houttuyn. |

<sup>1)</sup> Catalogue Rec. Echinida Brit. Mus. I, p. 60, t. 4, f. 2. AL. AGASSIZ, Rep. Challenger, p. 204, t. XXXVI, f. 1—3.

<sup>2)</sup> l. c., p. 61, t. 3, f. 4.

<sup>3)</sup> Rep. Challenger, p. 202, t. XXXVI, f. 8—13.

1879. *Schizaster japonicus* AL. AG. Proc. Amer. Acad., XIV,  
p. 212.  
»           »           »           » 1881. Challenger Rep., p.  
202, t. XXXVI,  
f. 8—13.

Under this species LINNÆUS in the S. N. ed. 10 referred to GUALTIERI t. 109 fig. *C*, which is a good representation of the well-known *Schizaster canaliferus* LAMCK., but at the same time subjoined under the *E. Spatagus* other figures of that same species: RONDELET's woodcut<sup>1)</sup>, rude enough to be taken almost as readily for the *Echinocardium cordatum*; BONANNI's figure, a repetition of that given by SCILLA<sup>2)</sup>; and IMPERATI's<sup>3)</sup>, both of the *Sch. canaliferus*, — a dubiousness which is best accounted for by the assumption that the original specimen of the *E. lacunosus* could no longer be compared. It was no doubt its absence that led to another serious confusion.

GUALTIERI had committed a singular mistake. On his 109th plate he had given two figures, *C* and *D*, the former a good representation of the dorsal side of a denuded *Schizaster canaliferus* LAMCK., the latter an indifferent one of the ventral aspect of an *Echinocardium cordatum* PENN., covered with its spines. In the explanation of the plate both are treated as different views of one and the same species, *C*, »vulgatissimus», »whitish», and a reference is added, to BREYNIUS, p. 61, t. V, fig. 1, 2, who describes and figures an *Echinocardium cordatum* from the Adriatic. Now, of this species a specimen from the North Sea had been described and figured by LISTER, as early as in 1685, and in 1746 LINNÆUS had introduced it with that quotation alone into the *Fauna Suecica*, having probably received it from the shores of the Cattegat, where it is common. On account of its extreme fragility it may be readily imagined that the specimen had soon been lost, for when the species reappears in his writings LINNÆUS evidently has become very doubtful where to place it. LISTER's delineation shows its ventral aspect, like that figure *D* with which GUALTIERI associated his fig. *C* as the dorsal view of one and the

1) De piscibus marinis, Leyden 1554, p. 580; repeated in: Hist. entière des poissons, I, p. 416.

2) De Corp. mar., t. 25, f. 2.

3) Historiæ naturalis libri XXXIX, ex italica in linguam conversa latinam. Colonæ, 1695, p. 911.

same species, and thus he was easily betrayed into placing the quotation of the Fauna Suecica under the *E. lacunosus*, and there it is seen in the MS Lecture of 1752. In the later works BREYN, t. 5, fig. 1, 2, is added, a good representation of the *E. cordatum* PENN. On the other hand this same species, as figured by D'ARGENVILLE t. 28 f. *M.*, occurs under the *E. Spatagus* in one of the MS Lectures but not in the others, — as if the Archiater had corrected a first and wrong dictation, — and then the reference to it disappears altogether, while the quotation: Fauna Suecica, 1290, with LISTER, App., are transferred from the *E. lacunosus* to the *E. Spatagus*, where also KLEIN, the French edition, t. 28, and a figure in GINANNI, are added, both representing the *Echinocardium cordatum* PENN. It is obvious that LINNÆUS was to the last undecided as to which of his two Spatangii this species might be supposed to approach, and left the matter *in suspensio*. OTTO FREDERIC MUELLER<sup>1)</sup> found at Dröbak in Norway the *Echinocardium cordatum*, and, apparently not having an opportunity of consulting the description in the Museum Ludovicæ Ulricæ, took it for the *E. lacunosus* of LINNÆUS, and sent a specimen thus labelled to LESKE, who figured it, t. 38 f. *F.*, under the erroneous name of *Spatangus pusillus*.

In the Lecture LINNÆUS added: »in a petrified state this species occurs on sea-shores, showing the areæ quite distinctly». He thus alludes to the tertiary fossils from the Isle of Malta and elsewhere in the Mediterranean which in our days have been described by DESMÔULINS and WRIGHT as *Schizaster Scillæ*, *Desori*, *Parkinsoni* etc.<sup>2)</sup> To such fossils, often seen in old collections, the quotation refers from KLEIN, the French edition, though perverted by misprints and probably to be read: t. 13, f. *A, B*, t. 15, f. *B*. At the former place, German ed. t. XXIII\* f. *A, B, C*, KLEIN had figured his »*Meliten-sia*», referring to *SCILLA*, t. 7, f. 1, and at the latter, Germ. ed., t. XXVII f. *A*, a somewhat larger form received from Italy.

<sup>1)</sup> Zoologia Danica, I, Danish letterpress of 1781, p. 19, footnote under *Spatangus purpureus*.

<sup>2)</sup> Ann. Mag. Nat. Hist., sec. ser., XV, p. 52.

14. ECHINUS ROSACEUS L.

Tab. 6, fig. 2.

ECHINUS planiusculus, ovatus, sublobatus, ambulacris  
quinis ovalibus, superficie punctata. Vulgo ro-  
saceus.

S. N. ed. 10, 1758:

*Rumph. mus. 36. t. 14, f. E.* Echinus planus Zeerealen  
dictus.

*Pet. amboin. t. 1 f. 10.*

*Bonan. recr. 1. t. 33.*

*Gualt. test. t. 110, f. A. C.*

*Klein, echinod. t. 17, f. 1, t. 18, f. 1, t. 19, f. A. B.*

S. N. ed. 12, 1767.

*Seba Mus. 3. t. 15, f. 11, 12, 13, 14, 23, 24, et t. 11,  
f. 2, 3.*

S. N. ed. 10, 1758, et ed. 12, 1767.

*Habitat in O. Asiatico.*

TESTA subovalis, convexo-plana, margine obtuso, vix  
quinelobo, cordato-ovalis.

*Supra* non reticulata, adpersa punctis eminentibus  
circulo inscriptis.

Centrum ex punctis perforatis, minimis, in orbem  
positis.

Radii 5, lanceolati, læviores, lateribus striati:  
striarum extremitatibus perforatis, apice parum  
mutilatis.

*Subtus* superficie superiori simili.

Centrum foramen orbiculatum.

Foramen juxta et infra apicem subrotundum,  
profundius.

S. N. ed. 12, add.

*Subtus lineæ a centro ad marginem radiant.*

In the Lecture 1752 LINNÆUS said: »is called: rosaceus».

The diagnosis then dictated ended with the word »ovalibus»; the two last words: »superficie punctata» were added in S. N. ed 10, 1758, to distinguish this species from the next, with which LINNÆUS had become acquainted during the interval.

But at the same time, through one of his hearers, a very serious mistake found its way into the diagnosis.

Three MS Lectures of 1752 have: ovatus, sublobatus, but a fourth, from mistaking the dictation: ovatus, subglobatus, which in the S. N. ed. 10, was emended to: ovato - subglobosus, and in the M. L. U., and S. N. ed. 12 to: ovato - subrotundus, a succession of faults that goes far to prove that some one of those disciples of LINNÆUS who were intrusted with copying the schedules and seeing his work through the press, in deciphering his rather illegible hand had consulted a copy like *b* of the Lectures, in this instance a source of grave error, and thus became guilty of this, and perhaps other mistakes in the M. L. U., as well as elsewhere.

The diagnosis restored to its true reading, as above, no more points to the West Indian species almost universally called *Clypeaster rosaceus*, but most decidedly to the species of the Eastern Seas commonly named *Clypeaster placunarius*. Of this the collection contains the specimen figured here, and there cannot be the least doubt that this, and no other, is the original type described by LINNÆUS. SWARTZ recognised it and fastened to it the printed label: *Echinus rosaceus*.

### *Clypeaster rosaceus* L.

#### Tab. 6, fig. 2.

KLEIN, Disp., 29, Scutum angulare, humile,  $\beta$ ., t. 19, f. A. B. orig., 1734. — GUALTIERI. t. 110, f. A, orig., 1742. — KLEIN, gall., t. 10, f. B, imit. Klein, 1754. — SEBA, Thes. t. 15. f. 11, 12, orig. 1759.

1758. *Echinus rosaceus* L. S. N. ed. 10, p. 665.  
 »       »       »   1764. M. L. U., p. 713.  
 »       »       »   1767. S. N. ed. 12, p. 1104.  
*Clypeaster* » (non L.) 2. var. *lineis quinque radiata*,  
 1816. LAMARCK, An. s. Vert. III,  
 p. 14.

1758. *Clypeaster rosaceus* (*non* L.)  $\beta$ , 1827. BORY, Enc. Méth. I, p. 141, t. 145, f. 1, 2, imit. Klein.
1855. *Echinanthus explanatus* GRAY, Cat. p. 7, t. 2, f. 1, orig.
1861. *Clypeaster placunarius* (*non* LAMCK.) MICHELIN, Mon. Clyp. p. 135, t. 35, f. 1, orig.

The form represented by KLEIN: t. 17, f. *A*, and t. 18, f. *B*, which is the *E. reticulatus* L.; t. 19, f. *A*, *B*, which is the *E. rosaceus* L.; t. 19, f. *C*, *D*, by DESMOULINS referred to the *Clypeaster ambiguus* LAMCK.<sup>1)</sup>, were all three united by LESKE<sup>2)</sup>, into one species which he proposed to call *Echinanthus humilis*, at the same time admitting it to be the *Echinus rosaceus* L.; reasons enough for dropping the name he gave.

That the *Scutella placunaria* LAMCK.<sup>3)</sup> cannot have been a *Clypeaster* is evident from the words: »ambulacris angustis linearibus, apice disjunctis» in its diagnosis. BLAINVILLE<sup>4)</sup>, after having examined the type specimen in the collection of the Duke of RIVOLI, placed it in the genus *Echinodiscus*, characterised by: »ambulacres divergeant par la séparation complète de chaque ligne de doubles pores. Pores génitaux au nombre de quatre». The name *placunarius* therefore is to be dismissed here. It is possible that GRAY used it for an *E. rosaceus* L., of which species MICHELIN gave an excellent figure as *Cl. placunarius* LAMCK.

<sup>1)</sup> Called *Sc. ambigena* LAMCK., Hist. An. s. v., III, 12, a misprint which has been perpetuated universally, although corrected many years ago by BORY DE ST VINCENT, Enc. méth. I, Explic., p. 142.

<sup>2)</sup> Addit. p. 29, 187.

<sup>3)</sup> Hist. An. s. v., III, p. 12.

<sup>4)</sup> Dict. Sc. N., LX, p. 199, 1830; Man. d'Act., p. 218, 1834.

## 15. ECHINUS RETICULATUS L.

ECHINUS planiusculus ovatus integer: ambulacris quinque ovalibus, superficie reticulata.

S. N. ed. 10, 1758. M. L. U. 1764. S. N. ed. 12, 1767.

*Sloane, Jam. 2, p. , t. 242, f. 7—10.*

*Gualtieri, test. t. 110, f. D.*

S. N. ed. 10 et 12.

*Habitat in O. Americano.*

This species is not in the Lectures of 1752; it was added to the Cabinet afterwards, probably in 1754, by DAHLBERG, together with the two other common West-Indian species: *E. Lucunter* and *Brissus columbaris*. There is no description appended to the diagnosis in the M. L. U., where also the diagnosis is perverted by a serious misprint: »niger» for »integer», rightly given in both editions of the S. N.

In the collection a specimen is preserved of the very common West Indian species generally known by the name of *rosaceus*. It is placed in the same box with the foregoing and over it, but there is no printed label.

In the diagnosis the third term: »integer» answers to »sublobatus», the third term in that of the *E. rosaceus*, and the closing words of this: »superficie punctata», correspond to »superficie reticulata» in the *E. reticulatus*. The difference in the sculpture of the surface is, however, very slight, the tubercles being perhaps somewhat more crowded in the *E. reticulatus*, in particular, as usual, on the ventral side and near the margin, where the reticular disposition of the granula marking the deepened scrobicules is rather more distinct.

Of the two references the one to SLOANE only holds good, and it is worth remarking that in the M. L. U. 1764 this is given: »fig. 7, 8, 9, 10», but in the S. N. ed. 10, 1758: »f. 7—10», the reference *in extenso* at the former place suggesting that LINNÆUS already in 1754 inserted the two new species of

Echinoids into his manuscript of the M. L. U., and afterwards, when preparing the tenth edition of the S. N. in 1757, abridged this quotation.

GUALTIERI's t. 110, f. *D*, represents a species unknown to LINNÆUS, which in time became the *Clypeaster scutiformis* LAMCK.

LÜTKEN who took care to consult the M. L. U., long ago had a presentiment that it would be rational to give the name of *reticulatus* L. to the species with the habitat: »*Oceanus Americanus*», and the name *rosaceus* to the *Cl. placunarius* AUCT., a view that has been singularly confirmed by the presence of the type specimen of the latter in the Queen's Cabinet, and by the emendation of its diagnosis. When LINNÆUS in 1752 described that Asiatic species as his *E. rosaceus*, he was unacquainted with the American one, and subjoined under the former all figures at hand, that by their general character appeared to associate with it. Later he added KLEIN, t. 17, f. *A*, and t. 18, f. *B*, which represent his *E. reticulatus*, and lastly, in the S. N. ed. 12, 1767, the two figures in SEBA, t. 11, f. 2, 3, of which it is expressly stated that the former is from Asia, the latter from America. There can, however, be no doubt that both represent the well-known West Indian species:

### **Clypeaster reticulatus L.**

SLOANE, Jamaica, t. 242, f. 6, 7, 8, 9 et 10, 11. orig., 1725.  
 — KLEIN, Disp. p. 29: Scutum angulare humile, *c*), t. 17, f. *A*, t. 18, f. *B*, orig., 1734. — KLEIN, gall., p. 85, t. 9, f. *B*, imit. Klein, 1754.  
 — SEBA, Thes., t. 11, f. 2, 3, orig., 1759. — KNORR, Del., t. *DI*, f. 12, orig., 1778.

1758. *Echinus reticulatus* L. S. N. ed. 10, p. 666.  
     »          »          » 1764. M. L. U., p. 714.  
     »          »          » 1767. S. N. ed. 12, p. 1104.  
     »          »          » 1770. HOUTTUYN, Natuurl. Hist.,  
   XIV, p. 524, t. 114, f. 7, orig.  
     »          »          » 1775. ST. MÜLLER, Natursyst., VI,  
   p. 154, t. 8, f. 7, imit.  
   Houttuyn.

1816. *Clypeaster rosaceus* (*non* L.) LAMARCK., An. s. v., III, p. 14, excl. var.



1816. *Clypeaster rosaceus* (*non* L.) 1817. BLAINV. Dict. sc. n., IX,  
p. 449.
- » » » 1827. BORY DE ST. VINC., Enc.  
Méth., Expl., p. 141,  
t. 144, f. 7, 8, imit.  
Klein.
- » » » 1830. BLAINV., Dict. s. n., LX,  
p. 197.
- » » » 1834. Id., Man. d'Act., p. 216,  
t. 17, f. 1, 2, orig.
- » » » 1837. DESMOULINS, Etudes, p.  
212.
- » » » 1846. M. EDWARDS, CUV., R. A.  
ed. ill., Zooph., t. 16,  
f. 1, orig.
- » » » 1847. AG. DES., C. R., p. 71.
- » » » 1861. MICHELIN, Mon. Clyp.,  
p. 110, t. 13, f. solito  
compressior, orig.
- » » » 1864. LÜTKEN, Bidrag, p. 100.
- Echinanthus » » 1855. GRAY, Cat., p. 4.
- » » » 1872. AL. AG., p. 106, 311,  
t. XI<sup>d</sup>, f. 1, 2; t. XI<sup>f</sup>,  
f. 1—18; t. XIII, f. 9,  
orig.

16. ECHINUS PLACENTA L.

ECHINUS planus, orbiculatus, ambulacris quinis bipartitis, ano marginali.

Prælectiones 1752.

*Gualtieri, t. 110, f. G.*

S. N. ed. 10, 1758, M. L. U., 1764, et S. N. ed. 12, add.

*Rumph. mus. t. 14, f. G.*

*Pet. amb. t. 11, f. 5.*

*Breyn, echin. 64, t. 7, f. 7, 8.*

*Klein, echin. t. 20, f. A, B. (ed. germ.)*

S. N. ed. 10 et 12.

*Habitat in Oceano meridionali.*

TESTA orbiculata, plana, inermis, margine quinques obsolete emarginato, æquali: unica emarginatura profundiore; ante hanc foramen in pagina superiore.

*Supra striata.*

Foramen centrale obtuse quinquangulare.

Radii 5 alterni, lineares, excavati.

*Subtus striata punctis minimis, eminentibus, circulo inscriptis.*

Foramen centrale obtuse quinquangulare, cinctum area rotundo-pentagona.

Radii 5 lineares, superioribus oppositi.

5 latiores obsoleti.

The Lecture of 1752 has: »is called Placenta from its being flat as a pancake».

In the collection there are two well-preserved specimens with printed labels attached: *Echinus placenta*. »Foramen centrale» refers to the somewhat depressed »centrum». The »Radii lineares excavati» are the impressed median sutures

of the ambulacra. — The words: »ano marginali» are not in the original diagnosis of the Lectures.

There never was any doubt about the species.

### Arachnoides placenta L.

BREYN, Sched. p. 64, t. 7, f. 7, 8, orig., 1732. — KLEIN, Disp., p. 33, t. 20, f. A, B, orig. — GUALTIERI, t. 110, f. G, orig. — KLEIN, ed. gall., p. 98, t. 11, A, imit. Klein, 1754.

1758. Echinus placenta L. S. N. ed. 10, p. 666.

» » » 1764. M. L. U., p. 714.

» » » 1767. S. N. ed. 12, p. 1105.

» » » 1770. HOUTTUYN, Nat. Hist. 14, p. 525.

» » » 1775. ST. MÜLLER, Nat. Syst., VI, p. 154.

Scutella » » 1816. LAMCK., An. s. v., III, p. 11.

» » » 1827. BLAINV., Dict. sc. n., XLVIII, p. 225.

» » » 1827. Enc. Méth. t. 143, f. 11, 12, imit. Klein.

» » » 1837. DESMOULINS, Etudes, p. 228.

Echinodiscus » » 1830. BLAINV., Dict. sc. n., LX, p. 199.

» » » 1834. Id., Man. d'Act., p. 218.

Arachnoides » » 1841. AGASSIZ, Mon. Scut., p. 94, t. 21, f. 35—42.

» » » 1855. GRAY, Cat., p. 13.

» » » 1872. AL. AGASSIZ, Rev., p. 90, 531, t. 136, f. 1, 2.

» » » 1874. LOVÉN, Etudes, t. 51.

LESKE, who says he had never seen this species, gives descriptions from other authors.

17. ECHINUS ORBICULUS L.

ECHINUS planus (lobatus), (suborbiculatus), ambulacris quinis ovalibus, ano (remoto) subremoto.

α. Echinus planius lobatus, ambulacris quinis ovalibus. Foraminibus nullis pervius, lobatus.

*Gualt. test. t. 110, f. F. F.*

S. N. ed. 10, 1758; add.

*Klein echinod. t. 22, f. E. F.*

S. N. ed. 12, 1767, add.

*Seba mus. 3, t. 15, f. 15, 16, 19, 20, 1, 2.*

β. Echinus planus lobatus, ambulacris quinis ovalibus, foraminibus duobus pervius, lobatus.

*Gualt. test. t. 110, f. H. H.*

S. N. ed. 10, 1758, et M. L. U., 1764, add.

*Breyn. echin. 64, t. 7, f. 5, 6.*

S. N. ed. 10, 1758, et 12, 1767, add.

*Klein ech. t. 22, f. A, B. (ed. germ.)*

S. N. ed. 10 et 12.

γ. Foraminibus quinque pervius, indivisus.

*Pet. Mus. 19, f. 125.*

*Gualt. test. t. 110, f. E, E.*

*Klein echin., t. 21, f. C, D. (ed. germ.)*

S. N. ed. 12, add.

*Hugh. Barbad. 280, t. 24, f. 3, 4.*

*Seba mus. 3, t. 15, f. 7, 8, 9, 10.*

S. N. ed. 10 et ed. 12.

δ. Foraminibus nullis pervius, indivisus.

*Gualt. test. t. 110, f. B.*

*Breyn. echin. 64, t. 7, f. 1, 2.*

S. N. ed. 10 et 12.

*Habitat in M. indico.*

Of this Linnean species no specimen has been left in the collection. From its absence in the list of THUNBERG it may be concluded that it had been lost at Drottningholm during the lifetime of LINNÆUS and perhaps even before 1754, and that this is the cause of the confusion. Its limits were altered considerably in the course of time. In 1752 LINNÆUS dictated: »Echinus planus, lobatus; ambulacris quinque ovalibus». Is called the operculum. GUALTIERI, t. 110, f. *E, F, H*. It is divided into several lobes which do not always observe the like number and form; hence the old authors have split it into four species.» It follows from the term »lobatus», thus explained, and from the reference to GUALTIERI, that LINNÆUS originally had in view the two West African species, which now constitute the genus *Rotula*: the  $\beta$  and  $\gamma$  of the M. L. U., the former being the *R. digitata* LAMCK., GUALTIERI'S *H, H*<sup>1)</sup>, the latter the *R. dentata* LAMCK. He had observed that during growth their lobes increase in number and take altered shapes, and thence was led to regard them as varieties of one and the same species, into which he included also the West Indian *Mellita pentapora* GM., in the five »foramina» of which he thought he saw the beginning of a division into separate lobes.

In the M. L. U., published a long time afterwards, in 1764, this view is maintained without modification, and the detailed diagnoses of the  $\beta$  and the  $\gamma$  even seem to indicate that LINNÆUS had an eye to their distinctness as species. Long before, however, in the S. N. ed. 10, 1758, he had added a fourth form: » $\delta$ , foraminibus nullis pervius, indivisus», the present *Laganum orbiculare* GM., and for its sake had struck out the word »lobatus» of the diagnosis, and replaced it by »suborbiculatus». By this procedure the *Echinus orbiculus* L. became a »collective species», and so it remained in the S. N. ed. 12, 1767. Its name must be dropped, provided it may not, — as has been done in many similar cases — be applied to the one form alone, for which it was originally intended, the  $\alpha$  of the S. N. ed. 10, the *Rotula dentata* LAMCK., and the other Linnean varieties be placed under their respective species.

<sup>1)</sup> It is to be remembered that GUALTIERI'S t. 110, f. *F, F*, is a *Rotula digitata* (*H, H*) in which the two anterior »foramina» have broken through the margin so as to produce incisions, and that, in the drawing, the excretory opening has been misplaced. It is the *Rotula Gualtierii* of GRAY, Cat., p. 18, rightly transferred by AL'AGASSIZ to the *Rotula digitata*.

Among the references subjoined in the S. N. ed. 10, the one under  $\gamma$ : »PETIVER, Mus. 19, f. 125», is nowhere to be found. It probably means: PET. Mus. t. 126, f. 10, a wretched imitation of BOCCONE'S<sup>1)</sup> »*Echinus dentatus, compressus, Spatago affinis*», which gives the *Rotula dentata* LAMCK., and ought to stand under  $\alpha$ , the  $\gamma$  of the M. L. U. Of the references to SEBA, t. 15, added in the S. N. ed. 12, the f. 1, 2 belong to the *Echinodiscus auritus*, and f. 7, 8, to *Mellita sexforis*, which is also the species figured in HUGHES' Barbadoes, p. 280, t. 26, f. 3, 4.

All that LINNÆUS ever wrote on Echinoids is contained within the space of a few pages and was a few days' work at Drottningholm, in 1752 and 1754, the only time of his life he could allot to this part of the Animal Kingdom. He never reverted to it in after years. What he had written down, in the Queen's Cabinet, on the schedules from which in the ensuing autumn he dictated to his pupils, remained, save for a few additions, unaltered all through his subsequent zoological works.

The seventeen species here commented upon were all known to LINNÆUS from actual observation, and he never admitted any on the authority of others. When he was called away, from studies to which he had devoted himself for many years, to far distant regions of the biological firmament, they were all that he sighted, out of the whole constellation of the Echinoids all but unknown to him before. It may easily be believed that to him they were »a thesaurus», but the collection they formed was in reality, even for that time, of but modest pretensions; the Dutch had not permitted their choicer rarities to get abroad and adorn foreign Museums. Had the splendid *Astropyga radiata* and *Plagionotus pectoralis* from the cabinet of JONAS WITSEN at Amsterdam, the *Echinolampas oviformis*, the *Brissus carinatus*, and the *Metalia sternalis*, all figured in the work of SEBA, and the *Lobophora bifissa* in that of RUMPHIUS, been represented in the Queen's Cabinet, and along with them such other forms more or less recognisable in preceding authors, as the *Temnopleurus toreumaticus* in KLEIN's book, or the *Microcyphus foliatus* in GUALTIERI, and had LINNÆUS

<sup>1)</sup> Recherches, t. ad p. 273.

been acquainted with such common species near at hand as the *Strongylocentrus dröbakensis* and the *Spatangus purpureus*, all these materials would have afforded him a richer field of inquiry and given due expansion to his conception of the Echinoidean type, but the increased variety of different forms would not have induced him to regard them all otherwise than as members of one single genus. Before his time some authors, in their attempts to reduce into order the animal forms known to them, had thought to create natural genera by fixing on certain preconceived ideas of different structural combinations, and then inserting the species at hand into the compartments of the framework thus contrived, sometimes even with one or the other place prudently left open, in reserve for eventual accessions<sup>1)</sup>. Methods like this must have appeared »absurd» enough to one who, like LINNÆUS, taught<sup>2)</sup> that the Genus is given in Nature, and laid down the well-known maxim:

Scias Characterem non constituere Genus, sed Genus Characterem.

Characterem fluere e Genere, non Genus e Charactere.

Characterem non esse, ut Genus fiat, sed ut Genus noscatur.

In the whole of the Echinoids before him he saw only another of the many generical groups he had distinguished, and most of which still survive, developed into Families, Orders and even Classes rich in species distributed among numerous genera of narrower limits. Within his genus *Echinus*, however, scattered members of its type as were the species he knew or at any time saw, and brought together by chance rather than by selection, he was soon familiar with their leading features, created a terminology, and keenly appreciating even minor characters easily overlooked, caused them to reveal their different degrees of significance and affinity, and variously to approximate into beginnings of natural divisions, destined to attain future importance. First among the

<sup>1)</sup> Genera hinc sola natura duce, constituenda esse, secundum dictorum foraminum (aperturæ oris et ani) positionem, decrevi, moxque cum meis Echinis feci periculum; quod mihi in distributione eorum in Museo meo satis cessit feliciter: BREYN, Schediasma, p. 49. — KLEIN in his Tabula generalis Methodi Zoologicæ has: Animalia pedata, Cap. I, Sect. II, Class. IV. Pedum anteriorum digiti conjuncti, posteriorum fissi; ubi talia occurrunt. Dispositio Echinodermatum, p. 68. Compare CARUS, Gesch. d. Zool. in Deutschl., p. 477.

<sup>2)</sup> Phil. Bot., 159, p. 100; 162, p. 101; 169, p. 119.

Regulares he placed the huge *Echinus esculentus*, which still remains at the head of its now otherwise limited genus. By the common feature of the »puncta semipertusa», the lacunes of the epistroma, he connected the two: *Echinus globulus* and *E. sphaeroides*, and now it characterises the family of the *Temnopleuridæ*. He strongly pointed out, as standing forth among the rest in close relation, the *Echinus saxatilis* and *E. Diadema*, and the two are the nucleus of our family of the *Diadematidæ*. And just before them the peculiar aspect of its poriferous zones led him to place the heteropodous *Echinus Lixula*, and immediately after them the *Echinus Cidaris*, with its perforated mamelons, while the three concluding species represent the family of the *Echinometræ*. Among the Irregulares he recognised two types, the *Spatangidæ* and the *Clypeastridæ*, and placed these last, as the most divergent, at the farthest from the *Echini* proper, and with them ended the whole series. Thus he sent out his genus *Echinus*, like so many others, fraught with sound germs of future systematic development.

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## Explication of the plates.

### Plate 1.

The first schedule of the MS, in the handwriting of LINNÆUS, of the Museum Ludovicæ Ulricæ; fac-simile. Pag. 10.

### Plate 2.

Fig. 1—3, the original specimen of the *Echinus sphaeroides* L.; natural size. The fig. 2 presents in the middle the interradium 2. Pag. 68.

### Plate 3.

Fig. 1—3, the largest of the five original specimens of the *Echinus Lixula* L. The fig. 3 presents in the middle the interradium 4. Pag. 80, 97.

Fig. 4, 5, other original specimens.

Fig. 6, the original specimen of KLEIN's *Cidaris assulata pustulosa*  $\beta$ , in the Museum of the University at Erlangen. Pag. 85.

Fig. 7, 8, and 9, specimens from the Bight of Guinea. Pag. 103.

All the figures natural size.

### Plate 4.

Fig. 1—3, the original specimen of the *Echinus Diadema* L., natural size. The fig. 2 presents in the middle the ambulacrum I. Pag. 125.

### Plate 5.

Fig. 1—2, the original specimen of the *Echinus Cidaris* L., natural size. The fig. 2 presents in the middle the interradium 4. Pag. 138.

### Plate 6.

Fig. 1, the original specimen of the *Echinus Spatagus* L.; natural size. Pag. 160.

Fig. 2, the original specimen of the *Echinus rosaceus* L.; natural size. Pag. 171.

### Plate 7.

Fig. 1, a part of the test of the *Echinus Lixula* L., showing the epistroma. Pag. 86.

Fig. 2, the calycine system and surrounding parts in a specimen of the same from Liberia. Pag. 103.

Fig. 3, the epistroma in the *Arbacia spathuligera* VAL. Pag. 86.

Fig. 4, the same in the *Arbacia punctulata* LAMCK. Pag. 86.

All the figures magnified.

#### Plate 8.

Fig. 1—8, early states and development of the epistroma in the *Arbacia æquituberculata* BLV. Pag. 87.

All the figures magnified.

#### Plate 9.

Fig. 1—6, early states and development of the epistroma in the *Arbacia æquituberculata* BLV. Pag. 89.

Fig. 7, 8, the same in the *Arbacia stellata* BLV. Pag. 91.

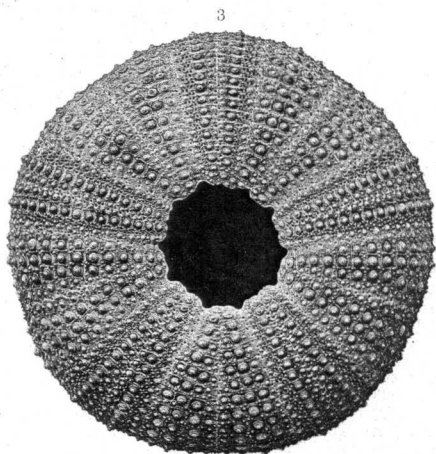
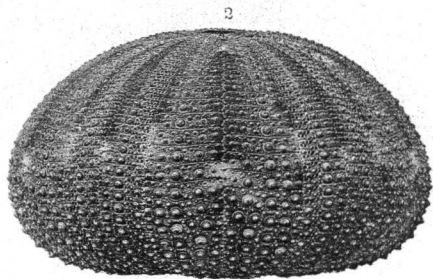
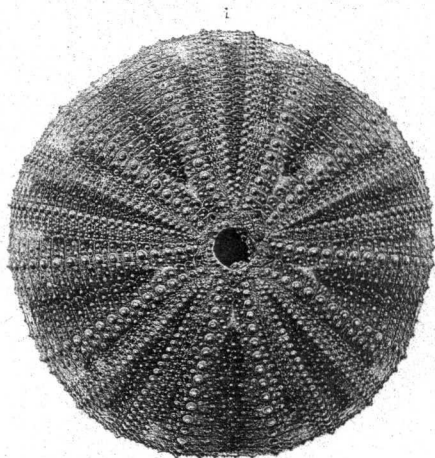
All the figures magnified.



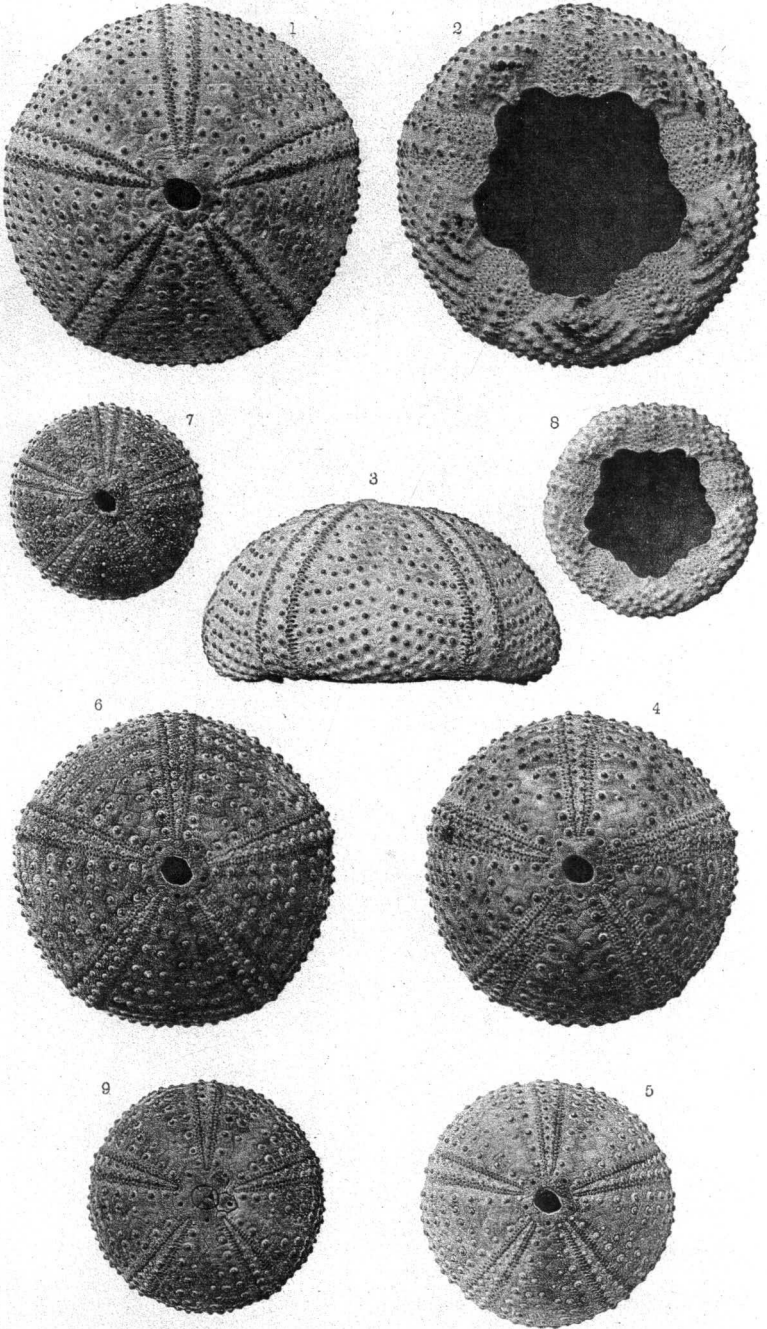
*Scorabius thoracicornis* maximo in cornu  
 eighty cornu recens <sup>partim dantida</sup>  
 Pet. fab. t. 10. p. 1. <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 unguiculis infra Pharyngem <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 unguiculis <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 habitus in Scieria <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 Thorax nigro glaber depressus subtrifidus in cornu  
 lato supra longius subulatus <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 subelytra supra barbata longitudinaliter  
 in medio utriusque dentibus obliquis  
 dente, apice cornu angustate.  
 Caput percipitur in cornu compresso relatione  
 annuato, <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 supra rotatum, glabrum, thorax breviter  
 Antennae pedum adimulatae subulatae, ad primum  
 ovata ovale maxime, ultimis maxime  
 ovatae <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 pedum parva triangulari.  
 Elytra ovata compressa supra apice denticulata  
 glauca glabra, punctata, <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 adprimum  
 Pedum a longis longis <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 Ala <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 Femora glabra, laticornia apice <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 unguis, supra pedum parva unguis  
 laterali unguis reliqua parva <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 unguis unguis  
 Color albus <sup>partim. bot. 277. t. 10. p. 1. 162</sup>  
 Varietas datus minor, thorax utriusque cornu  
 2 breviter unguis unguis, nec denticulata  
 laterali unguis unguis.

Museum Ludovicae Ulricae.

The first schedule of the original manuscript.



*Echinus sphaeroides* L.  
Prototypen.

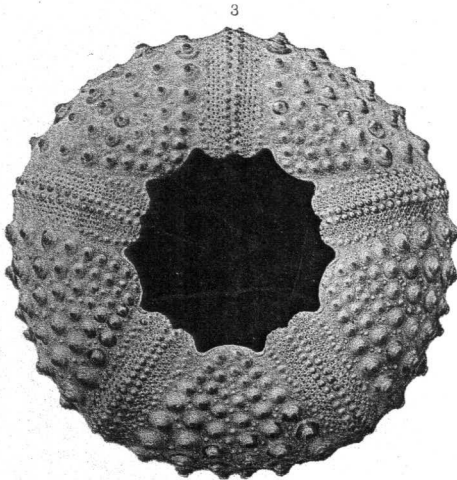
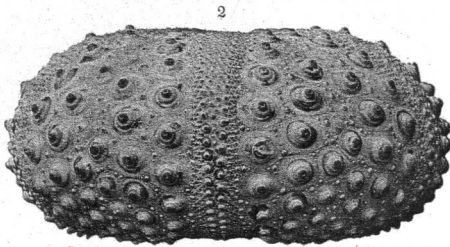
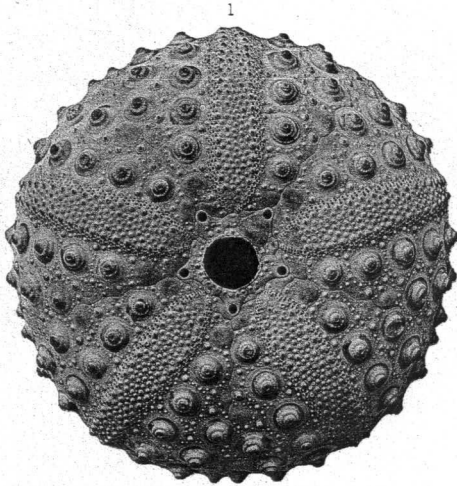


*Echinus Lixula* L.

6 Exempl. Kleini

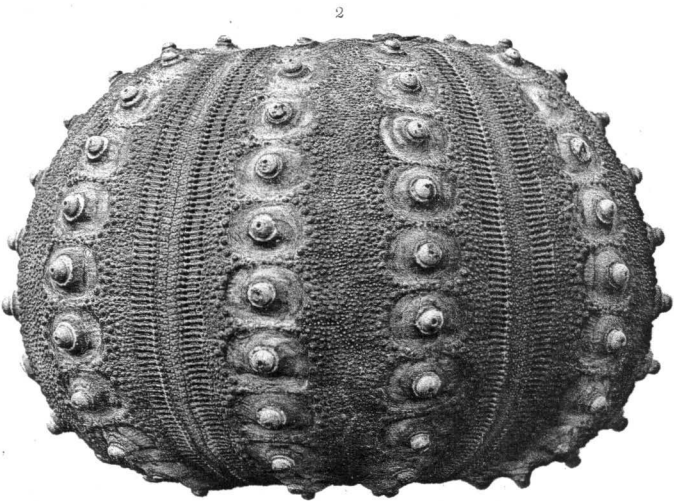
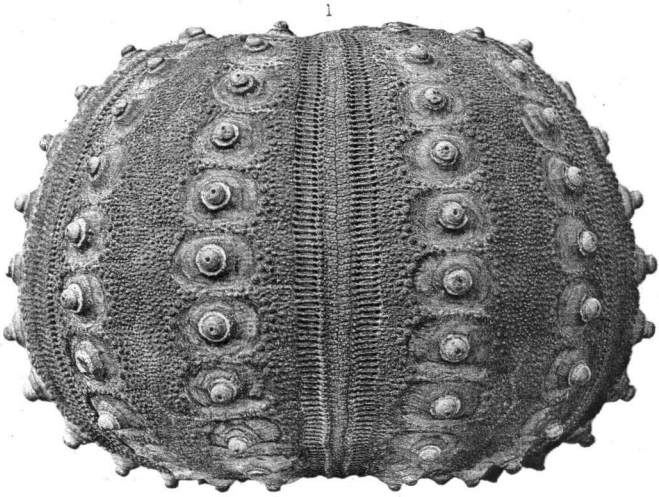
1-5 Prototypa

7-9 e Sinu Guinaico.



Echinus Diadema L.

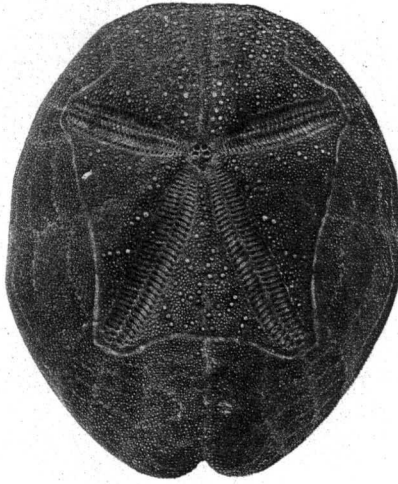
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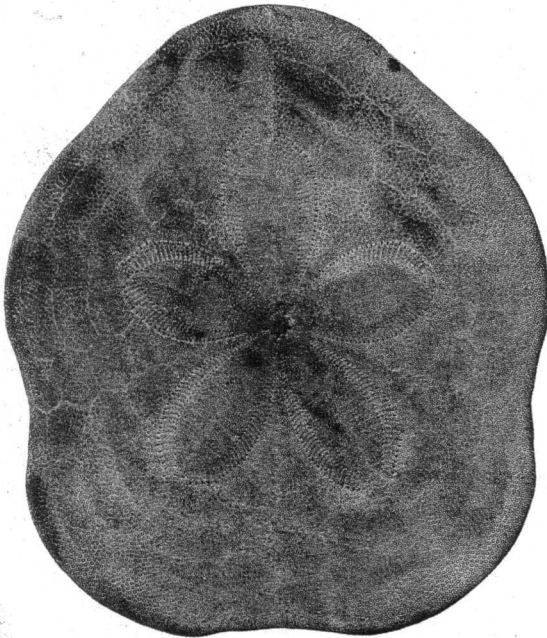
*Echinus Cidaris* L.

Prototypen.

1



2

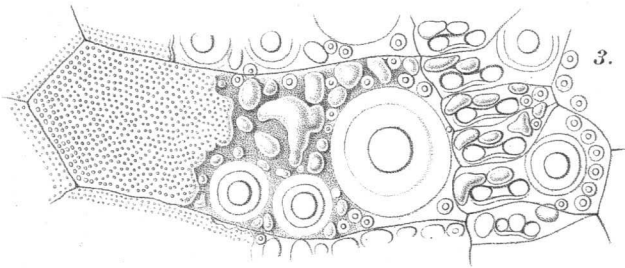
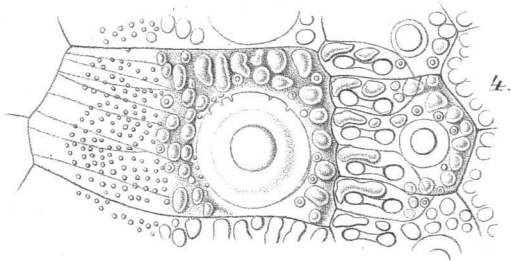
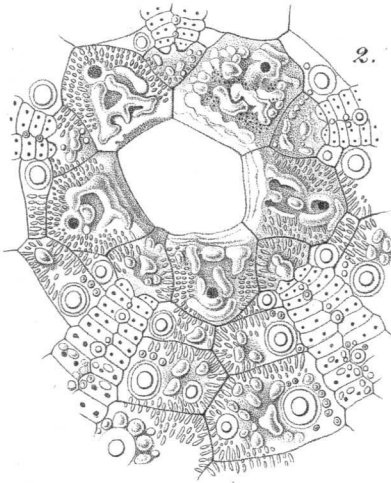
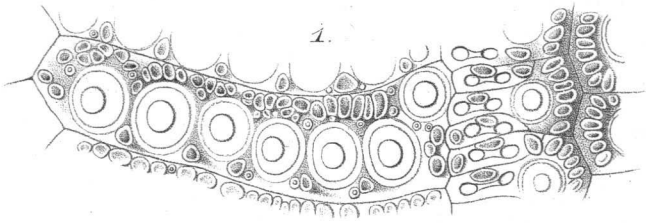


1. *Echinus spatagus* L.

2. *Echinus rosaceus* L.

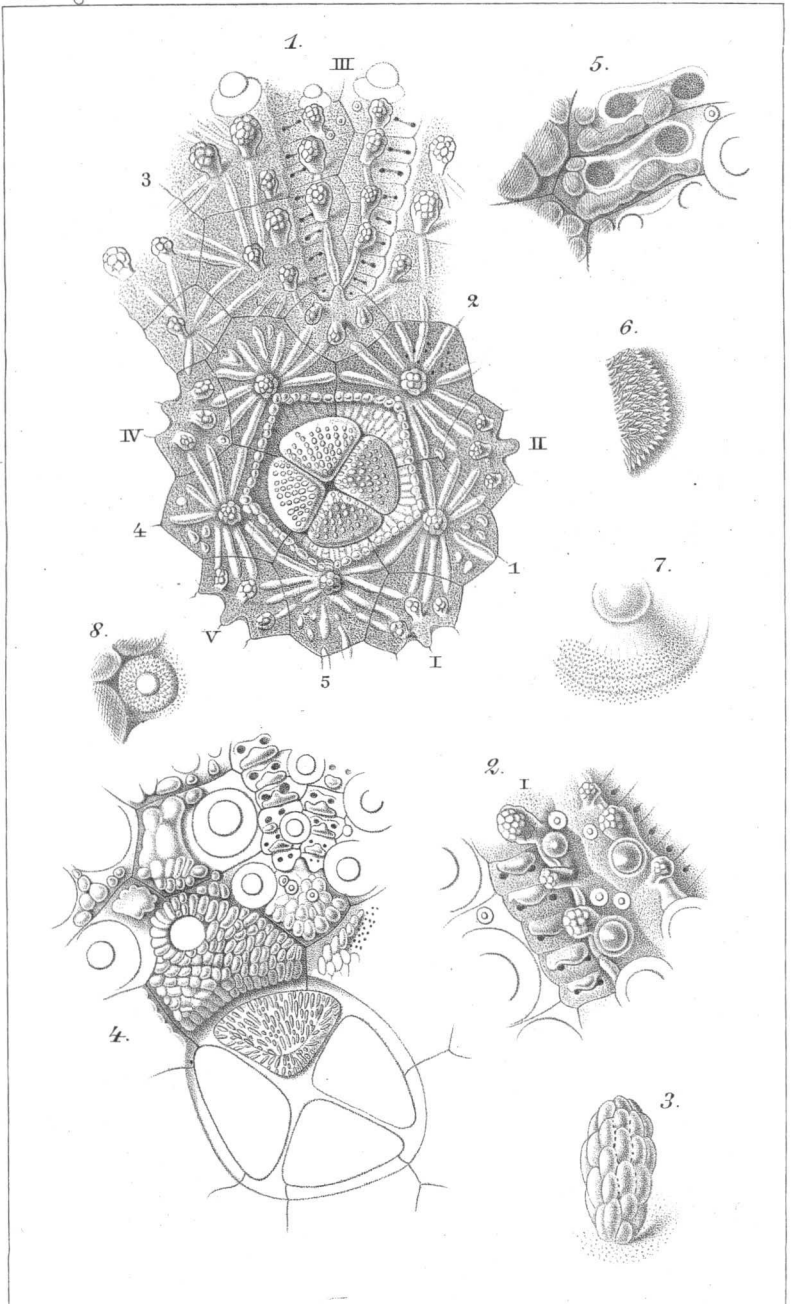
Prototypa.





A. M. Westergren del. Lovén dir. Lith. W. Schlachter, Stockholm.

1, 2. *Arbacia Lixula* L. 3. *A. spathuligera* VAL. 4. *A. punctulata* LAMK.

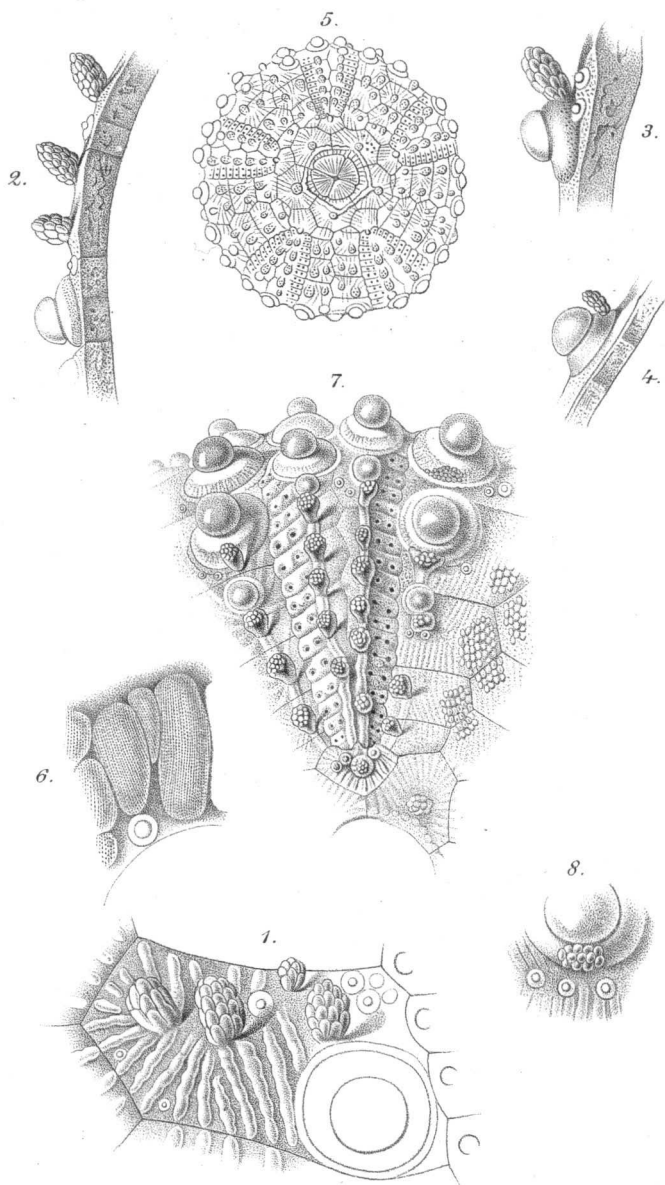


A.M.Westergren del.

Lovén dir.

Lith.W.Schlachter,Stockholm.

*Arbacia æquituberculata* BLV.



A.M. Westergren del.

Lovén dir.

Lith. W. Schlachter, Stockholm.

1-6. *Arbacia æquituberculata* BLV. 7,8 *A. stellata* BLV.