about the silence of Portuguese historiographers concerning the discovery, and these facts have generally been attributed to a desire on the part of the Portuguese to conceal their discovery from the Spaniards for fear of interference with their trade. A similar desire for concealment has been attributed on similar grounds to the Dutch, and has been sufficiently disproved. But there seems to have been no difficulty on the part of individuals who were really interested in the matter to obtain access to the original drawings, or to learn such details as were to be learnt regarding the discovery. Seven pilot-cartographers in France, Mercator, and others in Holland, taking a geographer's interest in a new discovery, found out, apparently, all they could know about it. The discovery was one of little interest to the Portuguese, whose only object was to discover fresh fields for their commerce, or to find better paths for their fleets. Australia was no field for commerce, the Australian route no route for their Indian fleets. Wytfliet, writing in 1598, says that after one voyage and another that route was deserted, and the country was seldom visited, except when sailors were driven thither by storms. As early as the days of Marco Polo, and at intervals ever since, the inhabitants have been characterised as cruel, and the shores as inhospitable, and no trade is said to have been practicable with the natives of that country. Hence the discovery was only regarded as important by map-makers, who probably threw aside the original charts as soon as they had incorporated them in their maps, or if these charts remained in Lisbon up to the time of the great earthquake, they may have then been destroyed, Their loss is not unique. What has become of the majority of the drawings from which the map of Tasman was constructed 100 years later? I do not say that a political motive may not have sealed the lips of the historiographers, although the reasons I have given as conducing to render unimportant the discovery of Jave la Grande would operate in their case also. In those days it was not uncommon for a ship to be blown upon an unknown and unlocated coast."

Mr. McClymont said that his remarks must not be regarded in the light of an original paper, as he had only followed in the lines laid down by Mr. Major in his painstaking work. He would be gratified if the acquisition of these maps, or anything he or any other member might say on the subject could awaken an interest in the subject of historical geography, which suffered from neglect. He had been surprised at the ignorance respecting Tasmanian discovery exhibited by all classes of the community. He thought the maps now acquired might very well form the nucleus of a Map Department in the Society's Library.

Mr. C. T. BELSTEAD, after alluding to the value of the key to the "Tasmanian Mosses," and the paper by Mr. Bastow, as also to the very interesting remarks by Mr. J. R. McClymont, proposed the usual vote of thanks, which was seconded by Lieut. BEDDOME, and supported by the CHAIRMAN. The proceedings then terminated.

AUGUST, 1886.

The monthly meeting of this society was held in the Society's rooms last evening, August 10, Mr. James Barnard, V.P., in the chair. Over 40 members were present and several visitors.

List of additions to the library during the month of July.

Annalen des K. K. Naturhistorischen Hofmuseums redigirt Von Dr. Franz Ritter Von Hauer, Band I., No. 2; Wien, 1882.—From the Society.

Annals and Magazines of Natural History, No. 102, Vol. 17; June, 1886.

Archives du Musée Teyler, Serie II., Troisièmere Partie.—From the Society.

Bollettino della Societa Geographica Italiana, Ser. II., Vol. XI., Maggio and Guigno, 1886, Anno XX., Fasc. 5, 6.—From the Society.

Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XII., No. 3. Observations on the development of Agelena raevia, by W. A. Locq, with 12 plates.—From Alexander Agassiz.

Catalogue de la Bibliothèque dressé par C. E. Ekama. Premier livraison, Encyclopedies, publications, academiques, et recuers periodiques.

Ditto, ditto, deuxieme, livraison, anatamoic physiologie, development, Hist. Nat. Universelle Hist. Nat. de différents pays; Anthropologique Ethnologie.—From the Society.

Catalogue of the fossil mammalia in the British Museum, part 3 containing the order Ungulata, suborders, Perissodactyla, Toxodontia, Condylarthra, and Amblypoda.—By Richard Lydekker, B.A.

Ditto, of the Passeriformes, or perching birds in the collection of the British Museum. Fringilliformes, part 3, containing the Families Cœrebidæ, Tanagridæ, and Icteridæ, by R. L. Sclater:—From the Trustees.

Geological Magazine, June, 1886.

Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum, part 6, by A. G. Butler. Introduction to the Study of Meteorites, with a list of the Meteorites represented in the collection (British Museum).—From the Trustees.

Journals and Papers of Parliament (Tasmania), Vols. 4, 5, 6, 1885.—From the Government.

Journal of the Society of Arts, May.

Monthly notices of the Royal Astronomical Society, Vol. XLVI., No. 7; May, 1886.—From the Society.

Nature. May.

Observations and researches made at the Hong Kong Observatory in the year 1835, by W. Doberеck.—From the Government.

President's address of the Royal Society of New South Wales, 1886, by Professor Liversidge.—From the author.

Summary report of the operations of the Geological and Natural History Survey to 31st December, 1885, being Part III. Annual report of the Department of the Interior, 1885. Geological and Natural History Survey of Canada.—From the Society.

Scientific Transactions of the Royal Dublin Society, Vol. III. (Series II.). VII.—Notes on the aspect of the planet Mars in 1884, accompanied by sketches made at Observatory, Birr Castle, by Otto Bœddicker, Ph. D., Plate VI. VIII.—On the Geological age of the North Atlantic Ocean, by Edw. Hall, L.L.D., Plates VII. VIII. XI.—On the changes of the radiation of heat from the moon during the total eclipse of 1884, Oct. 4, as measured at the Observatory, Birr. Castle, by Otto Bœddicker, Ph. D., Plates IX. X. X.—On the collection of the fossil Mammalia of Ireland in the Science and Art Museum, Dublin, by V. Ball, M.A., Plate XI., March, April, October, November, 1885.—From the Society.

Scientific Proceedings of the Royal Dublin Society, Vol. IV., N.S., Plates VII, VIII, IX, April, July, and October, 1885, Vol. X., N.S., Plates 1, 2, January, April.—From the Society.

Sixteenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the session 1885-6.—From the Society.

Société de Geographie, Nos. 9, 10, 11, 1886.—From the Société.

Statistical Register of the Colony of Victoria for the year 1885, Pt. 1, Blue Book.—From the Government Statist.

Verhandlungen der Gesellschaft Für Erdkunde zu Berlin, Band XIII., No. 5.—From the Society.

Victorian Naturalist, Vol. III., No. 3, July 3.—From the Society.

PAPERS.

1. On the Australian Pectens confounded with the New Zealand. P. laticostatus, Gray. By Professor Ralph Tate, F.G.S., F.L.S. In his paper Professor Tate states that though not indifferent to the opinions of certain conchologists, yet in this particular instance he considers their identifications incorrect, and surmises that they have been made without comparison of authentic specimens. Accompanying the paper is a table of dimensions of convex or right valve of Pectens, *laticostatus exoptandus*, *albus*, and *fumatus*.

Lieut. Beddome stated, in reference to the Tasmanian Pecten, that Mr. Brazier of Sydney had last year given the name *Pecten Meridonalis*, to our *Pecten*, and therefore he (Mr. Beddome) was under the impression that Mr. Brazier's name would take precedence of Professor Tate's *P. exoptandus*.

2. A paper entitled "Is Jupiter Self-luminous?" by Mr. A. B. Biggs, was in the absence of the author, read by the assistant secretary. The subject was one that the author had been paying particular attention to of late. In the opening part, Mr. Biggs stated that it was with some diffidence that he submitted the paper, partly because he was doubtful of its being a subject of general interest. Perhaps, however, the fact that the question which the author had set himself to solve is intimately connected with that of the physical condition of Jupiter, and inferentially also of all the giant planets may lend an additional interest to the subject.

3. Mr. R. M. JOHNSTON read the following paper entitled :—"Note on the Discovery of Plant Remains in the Tertiary Marine Beds at Table Cape, Tasmania. "In making excavations at Table Cape for the new breakwater, Mr. Bell, the local engineer, at my request, very kindly made up a collection of the fossils which he met with, and forwarded them to me. In this collection I found a number of very interesting leaf impressions, associated with *Turritella Warburtonii*, Woods, and other well-known marine forms obtained from the calcareous sandstones, described by me in the proceedings of the Royal Society of Tasmania for 1876 as "The Turritella Zone." In one of the leaf specimens I recognised the well-known form *Sapotacites oligoneuris*, Ettingshausen, which occurs in the leaf beds of the Derwent, notably at Pipe Clay Bluff and One Tree Point. The importance of this discovery is very great, as it now enables us to determine more accurately the relationship of the *Palæogene* (infra-basaltic) leaf beds of Tasmania with the Tertiary marine beds in South Australia, Victoria, Tasmania, and New Zealand. The *Turritella zone* at Table Cape from whence the leaf impression were obtained forms the uppermost series of beds of the formation at that place. It is characterised chiefly by the prevalence of the shell *T. Warburtonii*, Woods, and *Panopæa Agnewi*, Woods, although the common forms of the lower beds are also found in abundance. In all, I recognised 12 distinct species of leaves, somewhat resembling forms occurring in the leaf-beds of the Derwent and Tamar basins. One of the impressions is undoubtedly a species of *Pteris* which I propose to name P. Belli, in honour of Mr. Bell, who has added several novelties to the list of Tasmanian fossils.

In addition to the specimens of leaf impressions, Mr. Bell also collected a fine series of marine fossils, including corals and molluscs.

The most of these have already been described, but there are two forms new to Tasmania of great interest.

The first is a fine specimen of the well-known Cephalopod, *Aturia zic-zac* J. Sowerby, hitherto only found in Australia and New Zealand. The second is undoubtedly *Pecten lucens*, Tate, a species only recently described by Prof. Tate, from Aldinga, and the Murray Cliffs, S. Australia.

With respect to the occurrence of the plant remains among marine forms, it is most probable that the calcareous sandstones were formed at the mouth of an estuary or river, and that the leaves and other land organisms were washed down and included with the marine forms. This interpretation also throws some light upon the discovery of the almost complete skeleton of the species of *Halmaturus* already obtained from this same calcareous sandstone. The specimen referred to is still in the Tasmanian Museum.

In conclusion, Mr. JOHNSTON said he hoped that Mr. Bell would continue to make observations in this interesting locality.

In submitting a new catalogue of Tasmanian tertiary fossils, Mr. JOHNSTON stated that it was now about eight years since a comprehensive catalogue of the tertiary fossils of Tasmania had been given to the world, and since then a great deal of work had been done, and very great additions had been made to the list then given. It was very desirable, in order that workers might ascertain what had been done, that a comprehensive and specific list should be given directing where distinct information might be gained. Accordingly he had prepared a descriptive list embracing what was known of the tertiary fossils, including some 380 species, and presented it to the Society in the hope that it would be found of service. He also presented the Museum with a number of rock types from which the interesting plant fossils had been obtained at Table Cape, and a fossil nautilus shell from the same locality, which was frequently found in Victoria, but had not previously been recorded in Tasmania.

4. Mr. A. MAULT read a long and able paper upon the "Drainage and Sewerage of Hobart," in which he contrasted the relative merits of surface drainage with underground drainage. He found that to complete the system of surface drainage and make provision for effectively carrying it out would cost a further outlay of £20,000, and the annual cost of keeping it in order would be—after providing £9,000 annually for emptying pails and interest on £20,000—£16,300. Against this, a system of underground sewers to receive water closets, and carry the drainage system right out into the tideway of the estuary, could be constructed for £60,000, and the annual expense, including interest on that outlay, would be only £7,000. Under the latter system, provision could be made for mechanical or chemical purification of the sewerage before it reached the outlets; and it could be discharged at half ebb tide so as to ensure its being carried out clear of Sullivan's Cove and Sandy Bay, though this would only be necessary in the case of the Battery Point sewer. Hobart was peculiarly favoured for such a disposition of its sewerage as fifteen million tons of fresh water flowed down the Derwent daily, and the $1\frac{2}{3}$ tons of solid fæcal matter that would be carried away in the sewerage by the institution of a general system of water closets would not be appreciable in this immense body of continually moving water. The whole question was the disposition of the liquid excreta and house-slops, as the addition of the solids was nothing in comparison with this. In Liverpool, with a population 26 times that of Hobart, and where the area of land drained by the Mersey was much smaller than the Derwent, notwithstanding these adverse circumstances, the system he advocated was found to work well, and though the rate of mortality was high there it was a densely packed town,

and statistics showed that it had greatly improved in the rate of mortality. In reply to the objection that sewerage should be applied to the land, he pointed out that the expense of doing so at Hobart would prevent its being done. And, in conclusion, quoted the opinion of Sir J. B. Lawes, that when sewage was turned into an estuary a harvest was reaped from it out of the sea, that was more valuable than could possibly be obtained from the land.

Mr. W. H. CHARPENTIER said it would be almost presumption on his part to offer any remarks on the subject after such an able paper, but he thought it was well-known he was not in favour of the underground system of drainage. The difficulty, to his mind, was whether, when it was got into the river, could they be sure it would be got away from Hobart. Anyone walking towards Long Point would find refuse, rubbish, and even excreta from ships in the harbour and from the rivulet thrown up on the beach there. These was also—he supposed he ought not to say so—gas tar or something resembling it. There was a line of tide running directly on to the beach at the point, and the difficulty would be to get the drainage past that point. A gentleman like Mr. Mault, if he had time and money enough, could take the sewerage up Mount Wellington and then out to the ocean; but the estimate given for the probable cost of taking the underground sewers into the estuary could only be guess work, and would probably cost a great deal more. Without trained workmen were obtained explosions and great additional expenditure might be looked for. In England they had men skilled in the construction of drains to supervise such works at every point, but here we would have to manufacture the men first. He next alluded to the dry earth system as carried out at Manchester, where a profit of £16,000 was made out of the municipal works carried on in connection during the last year he was acquainted with its operations. It was a fact that typhoid fever was always found wherever the water closet system was adopted. Manchester had a million of inhabitants, and the works for turning the earth closet matter into a marketable manure, for which the farmers were willing to give£3 16s. a ton, occupied 16 acres. If Manchester could make a profit of £16,000 out of these very expensive works we might learn a lesson from her, or, at all events, make some enquiry into the manner in which the Dolly Varden system was worked. In his opinion modern science was able to cope with the difficulty, and there was no necessity to take such a retrograde step as go back to the Roman system of a vast cloaca. He urged that the surface drains would be perfectly inoffensive here if the roads were properly made, and the corporation labourers worked with energy instead of following their brooms like a blind man does his dog, and spending the greater portion of the day talking.

Dr. PERKINS said he came to the discussion to listen to what others might have to say, as his views were pretty well known, and he was more desirous of hearing such views as were held by the last speaker and others who had thought over the matter. He was prepared to receive suggestions, and to adopt any plan which could be shown to be better than the one proposed. Personally he thought Mr. Mault had touched the point of the question when he said it resolved itself into the disposition of the liquids and house slops. At Manchester these had been discharged into the Irwell, and proceedings were being taken against the corporation for polluting the river. The water-closet system was also used at Manchester, and to show what the mayor and aldermen thought of it, it was used at the Town Hall in preference to the Dolly Varden system. The latter system made no provision for disposing of the liquids, and consequently the river was polluted. It was not returning to any antiquated practice in a bad

sense, and he believed the great Roman Cloaca was not built for a sewer, but to drain the Pontine Marshes and other low ground. But if water-carriage was the best system it was none the worse for being antiquated. In Torquay and Brighton, in England, and at Porto Bello, near Edinburgh, the whole sewerage was poured directly into the sea. What they had to discover was whether Mr. Mault was on the right track—whether he was advocating the right system—and not the details. He believed Mr. Mault had not taken the outlets sufficiently far out into the stream, and in their further extension, but there would not be any difficulty in discovering that point. At Adelaide, £350,000 had been spent upon underground drains, and Adelaide was now the best drained city in Australia, where outbreaks of typhoid similar to those in Melbourne were never known. It was true that Adelaide had secured her boon at a great expense, but it was a much larger city than Hobart, and was not nearly so favourably situated in physical facilities. Correct tracings of the currents in the Derwent could be obtained to guide the designs of such a work, but he could not say that he had witnessed what was described as the present state of the beach at Sandy Bay. The chief thing to consider was the physical characteristics of a locality. The Hobart sewerage could not be discharged on the land in the vicinity except at a very great cost, and Manchester could not discharge hers into the sea. Sir R. Rawlinson and other authorities had declared that it was better in some cases to pour the sewerage into the sea than on to the land. This was done at Liverpool, and the circumstances of Hobart were more like those of Liverpool than Manchester.

Dr. HARDY, who was heard by special leave as he was not a Fellow, said it was a question upon which men were divided, and each side, like politicians, was little likely to see any virtue on the other side. Personally he was not biassed, but prepared to alter his opinion, which was at present in favour of the system advocated by Mr. Mault, if good reasons could be given to him. He felt very strongly that all existing cesspits should be abolished. Adelaide was growing more healthy every year since the deep drains had been laid, but previously it was such an unhealthy city that he had refused a practice there. Manchester was an unfortunate place, for, having nothing but a small river, she was forced to seek for some system to meet her circumstances ; but London was a marvellously healthy city with a relatively smaller water supply than Hobart, and yet carries her drains into the river. People talked of the pollution of our noble river. As it did not pollute the Thames and the Mersey to any dangerous extent, it certainly could not affect the Derwent. He knew the drains in some parts of Hobart were at present very bad, and people who had come here to reside had left in consequence. He had made it a personal practise to avoid certain streets on account of the drains. The pan system had not remedied this in Melbourne, and had not proved a success there.

Dr. BINGHAM CROWTHER said he had a great deal more sympathy with the dry earth system ; it was importing a large amount of manure into the colony to fertilise our impoverished lands, and if we could dry our sewerage, and by chemical action make such a manure of it that the farmers would take it, we would be adding to the wealth of the colony. Underground drainage would cost an immense amount of money, which the people were barely prepared to pay at the present time. He attributed the typhoid fever at Launceston more to the cemeteries existing in the town, and the wretched cesspit system, more than the drainage.

Mr. SAVILLE-KENT stated that at present the sewerage flowing into the river did not affect the fish detrimentally, though the tar

referred to did, and frequently killed the fish in the fishing boat wells, besides rendering others unfit for food. He was not prepared to say what the effect would be if the whole sewerage was discharged into the river. He thought Mr. Charpentier had exaggerated the condition of Sandy Bay beach, for fish ponds situated near there for rearing delicate fish were not affected.

Mr. WARD thought some provision should be made for settling or precipitating tanks as, owing to a peculiar law, matter held in suspension in fresh water settled rapidly on coming into contact with salt water. In view of this the drains should only be discharged at ebb tide.

Mr. C. H. GRANT said the paper was a valuable one, and the discussion which had followed was also a most valuable one, and for these reasons he would move the adjournment of the debate till next meeting, in order that the society might have the benefit of the views of some gentlemen not present. While doing so, he had a word of warning to give to those who advocated the underground system. He had practical experience of the system in London, and elsewhere, and would warn them that the expense always exceeded the estimate. No doubt the facilities here were better than in Adelaide, but there they had spent £350,000. It would be found that in Hobart there would be heavy rock cuttings to materially increase the expense. Then there was the private expenditure for branch drains and closets. In his opinion a satisfactory trap for water-closets had yet to be found, and he would advise them to consider well the question of the cost of deep drains before adopting them.

Mr. JUSTIN MCCARTHY BROWNE said he had been a great advocate of the dry system for many years, but he was disposed to pay the greatest attention to the conclusions a gentleman like Mr. Mault, armed with the latest scientific opinions, arrived at. The difficulty of all dry earth closets was that they made no provision for the disposition of fluids.

THE DRAINAGE OF HOBART.

BY A. MAULT,
Engineer Inspector to the Board of Health.

Having lately had to report officially upon the sewerage of the City of Hobart, it has struck me that it might be useful to place before the Royal Society some facts and considerations connected with the subject. It is so important that the more it is discussed the better, provided that the discussion leads to the adoption, and the early adoption, of the best means to ameliorate the present condition of things.

To place the matter before you, allow me to make the following recapitulation from my official report to the Central Board of Health:—The area of the city is 1,270 acres; the population is about 25,000; the number of houses is about 4,500; the water supply is said to be equal to 65gal. a day to each inhabitant, or 330gal. to each house. There are probably 400 houses with water-closets, 600 with privies with moveable pails that are periodically emptied by the nightmen in the service of the corporation, and the remaining 3,500 have ordinary privies, the cesspools of which are emptied at much longer intervals of time. The length of public sewers is not accurately known, but the greater part of the city is without underground drainage. The length of streets is about 37 miles. The refuse of the city is at present dealt with as follows:—The more solid portion of the fæcal matter is disposed of in the water-closets and privies above-mentioned; the liquid portion of the