APRIL, 1899.

There was a large attendance at the monthly meeting of the Royal Society of Tasmania (the first of the 1899 session) at the Museum on Tuesday, 11th April, when Mr. Napier Bell's and other papers were read. His Lordship the Bishop of Tasmania (the Right Rev. Dr. Montgomery, D.D.) Vice-President, presided.

Apologies were read from the President (His Excellency the Governor), regretting his inability, through ill-health, to be present; Sir James Agnew, V.P., Mr. T. Stephens, V.P., and Hon. F. W. Piesse, M.L.C.

HISTORICAL SECTION.

The CHAIRMAN said the Society had seen fit to inaugurate a historical and geographical section, so as to obtain all that could possibly be gathered concerning the past history of the colony before it became too late. The section had now been formed, and he hoped every member interested in historical and geographical knowledge would give their names to Mr. Morton, so that the first meeting of the section might be called as soon as possible. (Applause).

PORT CYGNET ROCKS.

The SECRETARY (Mr. Alex. Morton) read a paper by Messrs. W. H. Twelvetrees, F.G.S., and W. F. Petterd, C.M.Z.S., on Haüyne-trachyte and allied rocks in the district of Port Cygnet and Oyster Cove. Igneous rock at Port Cygnet, in Southern Tasmania, has been well known for a long time by the name of felspar porphyry. The authors submit in this paper the results of field work and misroscopical examination, showing these porphyries to be soda trachytes containing the sodic minerals haüyne, aegirine, analcime, cataphoritic-hornblende, with melanite-garnet, sphene, zircon, and apatite as nearly constant accessories. It is pointed out that as haüyne in the first British phonolite (wolfrock, Cornwall) was discovered by the late Mr. Allport in 1871 by means of the microscope, the same instrument has led to the discovery of the same mineral in Tasmania. Geological sections round Lovett show the haüyne and garnetiferous trachytes to be interbedded with the permo-carboniferous beds, and consequently, geologically, contemporaneous with these. Beside these volcanic sheets, intrusive haüyne and other dyke rock have been found, as well as syenites containing elacolite and analcime. The group is thus represented by effusive, intrusive, and plutonic members, and the complete series forms a unique set of rocks, so far as Tasmania is concerned, as well as being apparently the first authentic occurrence in Australia. They are geologically important, as being the youngest matrix of gold in the colony. The trachytes appear to have shed the gold which has been won on the alluvial field at Lymington, and found in the gullies on Mount Mary. The authors also refer to sand from a creek a mile back from Little Oyster Cove, which contains flaky gold, numerous melanite-garnets, zircons, and small crystals of sphene. This sand is the detritus of the garnetiferous trachytes, and the occurrence in it of gold, associated with the minerals just named, supports the idea that the trachytes are the source of the gold throughout the whole province. At present there is no trustworthy evidence to show that the Port Cygnet quartz veins are auriferous, while on the other hand there is some reason for believing the trachytes themselves to contain, sparingly disseminated, gold, especially where they are silicified and brecciated. The miners are pursuing the right course in selecting these tuffaceous and siliceous zones for exploration. Whether the gold has been concentrated anywhere to a greater extent than in the parts hitherto exploited remains for future search to decide. The pyrite in these rocks has so far proved non-auriferous. Appearances are against the quartz veins being true lodes, and the quartz is so closely associated with and banded with trachyte that the assay results are inconclusive upon the question of the auriferous nature of the quartz. There is a remarkable development of melanite garnet in the trachyte and syenite, and this mineral runs through the whole series of rocks. The trachyte rock on the Livingstone Hill, N.E. of Lovett, crowded with large tabular crystals of orthoclase, furnishes the largest and most remarkable felspars in the island. Detached from the matrix they form fine cabinet specimens. The dark green, sometimes fissile, metamorphic looking rock on Mount Mary, west of Lovett, has been ascertained to be an aegirine trachyte, owing its colour to the needles of green soda pyroxene (aegirine) with which it is crowded. The syenitic looking rock on the back road N.E. of Lymington called "granite" locally, is shown to be a typical trachyte, while the dark rock on Cranny's farm, known as "basalt," is a dyke-diorite (malachite), a somewhat abnormal occurrence in this group of rocks. The Port Cygnet series extends to Oyster Cove. This small and peculiar petrographical province is a purely local one, confined, so far as is known to the authors, to this part of Tasmania. Its unexpected discovery may be placed to the credit of the young and expanding science of microscopical petrology.

Mr. R. M. Johnston, F.L.S., spoke eloquently of the splendid service rendered by the two gentlemen in the geological and mineralogical interests of the colony. He looked upon the information contained in the paper as calculated to interest geologists and other scientists throughout the world. (Applause.)

FOSSIL CORAL.

A paper by Mr. Robert Etheridge, jun., Curator of the Australasian Museum, Sydney, was read by the Secretary, which, he explained, was descriptive of a Tasmanian species of Halysites, a fossil coral obtained from the River Mersey. Mr. Stephens presented the Museum a polished specimen of the coral referred to by Mr. Etheridge in his paper.

Mr. Johnston explained the importance of the paper.

MACQUARIE HARBOUR:

Its Physical Aspect and Future Prospects.

By C. Napier Bell, M.Inst.C.E.

In the absence of Mr. Napier Bell from the meeting of the Royal Society of Tasmania on Tuesday evening, Mr. F. Back, A.I.C.E., F.S.S., etc., read Mr. Bell's paper on Macquarie Harbour as follows:—

Macquarie Harbour is an immense lagoon of 72,000 acres in extent (a lagoon being defined as a lake which has an entrance into the sea); it is about 25 miles long, and from five to seven miles wide, with several islands in it, and many deep bays and inlets on its shores. It lies in a S.E. and N.W. direction, nearly parallel to the sea coast, from which it is separated by a tongue of rough, rocky country only a mile or two wide at the entrance, but increasing in width towards the south end of the harbour. This tongue of land, separating the harbour from the sea, is, for several miles from Cape Sorell southward, composed of quartz rock with thick beds of sandstone altered into quartzite, and underneath this quartz is hard slate rock which outcrops on the seashore. Towards the south end of the harbour the land separating it from the sea rises into rough hills of slate covered with bush.

On the west side of the harbour the land is undulating, and slopes up to the high mountains at the back: it is mostly soft sandstone, shale, gravel, and other sedimentary strata, getting more sandy as you approach Strahan, between which and the sea the land is entirely made of white sand, with occasional beds of gravel and peat among it.

The harbour receives the rivers Gordon and King, with a combined watershed of 2,500 square miles, over which the yearly rainfall is about 100in. Very heavy storms of rain are frequent in this country, and a downpour of 2½in. in 24 hours is capable of filling the harbour 4½ft. above its ordinary level if this surplus was not emptied into the sea as fast as the rain supplied it.

A noticeable peculiarity of Macquarie Harbour is its great depth, which is from 80ft. to 120ft. all over its area, and even the narrow cove or inlet which forms the harbour at Strahan has over 90ft. of water, while at the south end is Kelly's Basin, a land-locked bay in which the largest man-o'-war could anchor. This peculiarity of great depth of water is found also in most of the rivers of this neighbourhood; thus the Gordon carries a depth of 40ft. to 60ft. for 15 miles from its mouth, although it has a bar of 12ft. where it enters Macquarie Harbour. The King is 30ft. to 40ft. deep for some miles up, though it has a bar of only 2ft. at its entrance with the harbour. But I am told that the Henty and Pieman, which discharge direct into the sea, are also very deep inside their bars.

I have thought much on this subject, but I have never found a satisfactory explanation of the unusual depth of these rivers; in New Zealand, rivers quite as big and quite as subject to floods are very shallow; the Brisbane River has more than twice the water-shed of the Gordon, and is visited by tremendous floods, but it is not half as deep; the Fitzroy River has 25 times the water-shed of the Gordon and floods up in places 70ft. high, but it is very shallow in its ordinary condition.

Speculations as to the origin or mode of formation of a lagoon like Macquarie Harbour are very uncertain in the absence of a thorough knowledge of the geology of the surrounding district. It appears to me that this locality was once a wide, open bay of the sea, bounded on the west by the rocky hills of the peninsula which ends in Cape Sorell, on the south, east, and north-east by the detached ranges of mountains and their projecting spurs which now lie a long way inland from the harbour, and reach the sea coast near the Pieman River mouth. The gravel, sand, and mud from the rivers and creeks would then have gradually made the sea coast on the south, east, and north-east sides to encroach on the bay until it began to assume something like its present shape, and then the action of the sea and the currents caused the formation of the great spit or tongue of sand and gravel which, extending from near Strahan, has closed in upon the entrance of what was then a sound or fiord, and has made it what it now is, a lagoon, which the sea has no power to entirely close up by reason of the strong currents of the tides which, rushing in and out of the lagoon, keep the mouth always open.

Such speculations as to the mode in which nature has thus formed a closed lagoon out of a wide bay are not so fanciful as some people might think ; hundreds of lagoons in other countries are proved to have been so formed ; but the most remarkable instance I know of is to be seen in New Zealand. On the west coast of the South Island there is a constant drift of the material of the beaches, whether shingle or sand, towards the north, caused by the oblique set of the prevailing S.W. waves on the beach. At the west opening of Cook's Strait this coastal drift is deflected towards the east by the prevailing S.W., W., and N.W. winds and waves, and has formed the Farewell Spit, a tongue of sand over 20 miles long, and from two to five miles wide, which encloses Blind and Massacre bays. It has been observed that this spit is extending and deflecting towards the land, the only source from which it can grow being the sand swept up the West Coast and washed along the spit to its end, and in the course of thousands of years it will entirely enclose Massacre Bay, and make an immense lagoon of it.

Some thousands of years ago the bar and the entrance of the harbour was many miles inside of its present position, which is shown by the extensive sand banks inside the entrance, but still more convincingly by great beds of wind-drifted sea sand which lie on the hill sides of Cape Sorell peninsula, many miles inside the present entrance, and facing the shore of the harbour. The quartz hills of the peninsula are covered with a more or less thick bed of peat, which adheres to the smooth face of the quartzite, so that no sea sand is found on that side except such as has crossed the entrance from the Strahan side. Under the conditions of deep water and strong currents sand can cross over only from the east to the west side on the bar, where the waves and the breakers drive it across. If, therefore, thick beds of pure white sea sand are found lying on the hill sides some miles inside of the present bar, the inference is that the bar was near them in those days, and has been pushed out to its present position by the drifting of the sand along the northern beach. There is no other source from which this action could arise, because the sand brought down by the Gordon, King, and numerous creeks stops at their mouths, as it cannot cross the deep water of the harbour, where there are no currents on the bottom.

The above conclusions would appear to contradict what I said in my report to the Government of December, 1897, viz., that it appeared that if there were any coast drift on the sea beach it was to the northward ; but there is no contradiction, because when there is a strong flood tide running into the harbour, the indraft is so great that it causes a powerful eddy of the sea water for nearly a mile and a half along the north beach, where the sea water is seen flowing along the beach into the harbour. and, of course, carrying the sand with it ; but beyond the mile and a half the appearances are as if there was a drift towards the north.

This circulation of sand at the entrance is very extraordinary, and several times I looked with astonishment when a powerful flood tide was rushing into the harbour to see the whole of the water yellow with sand in such vast quantities that one was inclined to fear that the whole harbour would be presently filled up with it ; but, then, after some days, the water ebbed out with even greater violence, and then the stream of sand flowing out to sea off all the sandbanks for miles up the harbour was equally astonishing. It would appear quite likely that the great sandbanks which obstruct the entrance are slowly growing, because one argues that the rough waves on the bar stir up the sand, which the flood tides carry into the harbour, where, meeting still water the sand settles to the bottom, and thus causes the slow growth of the sandbanks inside ; also the sudden drop of the shallow water into 50ft. and 60ft. depths inside the lagoon generally indicates either growth or movement of the banks by scours. But, however this may be, a close inspection of the old chart of 1819 does not disclose any change in position or depths of the sandbanks nor in the position or depth of the sea bar.

The water of Macquarie Harbour is salt, but the colour of it is dark brown, caused by the peaty water brought down by the rivers ; this water stains the rocks black, and even in the open sea at Pilot Bay the rocks are so stained, except when a heavy gale scours them white again. This brown water is evidently distasteful to fish, as there is not nearly so many in the harbour as one would expect ; but Mr. Alexander Morton has a salmon trout which was caught near Strahan, and if these become plentiful it will be a great improvement to the harbour.

A striking peculiarity is the erratic and peculiar character of the tides. There is only one tide in 24 hours, and the average height at the Heads is 2ft. 6in., but this varies so much with wind and weather, that it is impossible to predict the tides. Very often the tide is seen to be what sailors call bulling, that is, the tide falls for an hour or two, and then rises again to near its first height, and finally falls to low water. For half of the year high water is at night, and for the other half in the day time. Sometimes for days there is scarcely any tide, and the water does not run in or out, then without

apparent cause the tide will commence to rush into the harbour day and night with great force, until the water at Strahan and the Gordon has risen from 3ft. to sometimes 5ft., then it will start to ebb out with great velocity, sometimes ebbing for two or three days, with just a slight check at high water of the sea. Seafaring people say that when flood tide is pouring into the harbour bad weather is approaching, although at times it does so and no bad weather follows. It is true, however, that rough weather from the N.W. makes a strong inrush of the tide, causing the water to rise very high in the lagoon, and impounding the fresh water poured into it by the rivers, and as soon as the gale veers to the W. and S.W. the impounded water ebbs out with astonishing velocity and force, notwithstanding that the gale is unabated in strength. About the 26th of October, 1897, during a moderate gale at N.W. the flood tide poured into the harbour day and night for two or three days, till it filled up at Strahan 5ft. above ordinary level. The gale then increased to a heavy gale at W., and the harbour gave signs of ebbing; then it blew a very heavy gale at W.S.W. with a mountainous sea and tremendous breakers in the offing. Immediately the lagoon started to ebb in earnest, and on the evening of the 30th there was the most furious ebb tide I ever saw—the water roared in a cataract between Entrance Island and the Peninsula, and I do not think any steamer could have stemmed it. At 1 o'clock in the morning the ebb slackened, but at 8 a.m. it was still ebbing strongly. In the afternoon there was a repetition of the previous violent ebb, but not so strong; and next day the ebb was exhausted, although the S.W. gale had abated very little. This was a great gale, which lasted over a week; during its height I was astonished at the immense height of the breakers, and tried to fix the position of a line of heavy rollers with a sextant. When fine weather came I went in a steam launch to about the place where the breakers had been, and found there over 60ft. of water. Here I noticed what is often observed at both Greymouth and Westport—that the heavier the gale is apparently so much the smoother is the bar; the case being that in a strong gale the waves are all broken up in deeper water outside, and those which reach the bar are moderately small waves. At any rate, during the height of this gale the steamer Australia came in over the bar without any trouble, although it was a marvel to me how she ran through the lines of immense breakers outside the bar, and this part of her performance I did not see.

Returning to the curious action of the tide in Macquarie Harbour, it may be observed that this great tidal backwater acts like a sort of gauge, or barometer, to show up pulsations in the sea which could not otherwise be detected. Recent careful observations in the Lake of Geneva have shown that the surface of the lake rises and falls in a very mysterious manner, sometimes at one end and then at the other, sometimes in the middle and not at the sides. This has been supposed to be due at times to local winds, or to variations in the pressure of the air, even to part of the lake being covered with cloud and part not so covered, or to the passing of a distant steamer; but, in the absence of any of these supposed causes, the phenomenon remains unexplained. Now, if a lake acts like this, how much more may we suppose the sea to be liable to the same effects, which may help to explain the mysterious ebbing and flowing in Macquarie Harbour, often without apparent cause, when the harbour is seen to be ebbing out while the tide is rising, and flowing in when the tide is falling, or at times a powerful flood tide rushes in without any reason given from the sea tides, or from any apparent change in the weather.

Another interesting although well-known effect is seen in this harbour, called the throttling of the tides. In still weather, when no abnormal action is taking place, a rise of tides at the Heads of, say, 2ft. 6in. will raise the water at Strahan or the Gordon only about 1ft., so that the water in the lagoon neither rises so high nor falls so low as it does in the sea. This happens because the sea cannot get over the bar and the shallow parts near the entrance in time to fill up the harbour before the tide begins to fall, and, contrariwise, the water cannot get out quick enough before the tide at sea begins to rise. If the bar and the channel through the shoals were considerably deepened, the throttling of the tides would be greatly lessened, with the effect of causing still more sea water to pass in and out, and so increasing the scour; in Greymouth, New Zealand, after the completion of the breakwaters, and the bar had deepened from 6ft. or 8ft. to 22ft., it was found that the low water level at two miles from the entrance had fallen nearly 4ft., while the H.W. level remained the same. After noticing the strength of the currents which flow in and out of Macquarie Harbour, it is to be observed that there is absolutely no current one way or the other in the harbour: the body of water is so deep and large that however violently the tides, even when combined with great floods in the rivers, may be rushing out into the sea, the body of the water in the harbour is quite still, its function being confined to simply rising and falling in surface level.

The bar at Macquarie Harbour is

situated over 4,000ft. outside of Entrance Island ; it is really a semicircular shoal of sand, extending from the north shore to the rocky peninsula on the south side, with a depth of about 8ft. 6in. in the line where steamers pass out, but the depth varies continually, and it has the great advantage that it is always deepest in bad weather ; in onshore gales it is often 13ft. deep.

If Macquarie had a deep entrance, it would be one of the finest harbours in these colonies. Nature does not always make fine harbours where they are wanted; she leaves it for men to make them for themselves or go without, and where a harbour is badly wanted, men generally contrive to make one by some means or other. If it had not been for the discovery of the rich mineral country in this part of Tasmania, Macquarie Harbour might have been left to the swans and the pelicans ; but the necessity for a deeper entrance has now become sufficiently urgent, and after suffering the pangs of fear and doubt the colony has at last made up its mind to take the work in hand. There does not appear to have been any grounds for doubt or anxiety as to the result of the contemplated works, as the effect has been proved on dozens of harbours which have carried out similar works, and although the newspapers cited as a warning some cases of dismal failure of harbour works in New Zealand, they were not harbours of this kind at all, and the success of them was at least doubtful from the beginning. All those that have failed were enclosed harbours built off an open beach, where the well-known coastal drift was disregarded, which has now overwhelmed one and gives serious trouble in two others.

Of course, if breakwaters are projected out to sea from a beach which constantly drifts in one direction, nothing can save such a harbour from being silted up, unless it has the motive power within itself to keep its entrance clear, or unless it is kept clear artificially by dredging or scouring. Thus the harbours of Calais and Dunkirk, where there is a constant drift of the beaches from west to east, have their entrances kept clear by sluicing the channel from artificial sluicing basins, and assisted by dredging ; while the harbour of Timaru, in New Zealand, is kept open by a suction dredge.

But harbours which have the motive power within themselves do not require artificial assistance to keep their channels open to the sea if their natural current is controlled by suitable works, even although they may have to contend with the troublesome coastal drift ; thus the harbours of Westport and Greymouth, though exposed to the full violence of the sea, and having besides to contend with the constant drift of the beaches towards the north, and with vast quantities of sand and shingle brought down by the rivers, maintain their channel out to sea at a regular depth of about 15ft. at L.W.S.T. or 24ft. at H.W., and have done so for the last 10 years without apparent change. As the tidal basins of these two harbours are very small, the run of the tides in and out twice every day is not strong enough to keep their channels clear, consequently when floods in the rivers fail, the channels gradually shoal up. But floods never fail for very long, and the first flood in the river restores the depth.

Now, in the case of Macquarie Harbour there is not only an enormous tidal basin of 72,000 acres, but the two rivers, Gordon and King, have a larger water shed than the Buller River in Westport, with the same rainfall of 100in., and quite as frequently flooded ; in addition to these advantages there is no direct evidence of general drift in the sea beach, and the sand and debris of the rivers cannot reach the entrance because it cannot cross the deep water of the harbour, where, as I said above, there is no current ; also it is to be observed that in Greymouth and Westport the rivers bring down shingle up to some the size of a man's head, which has to be swept out to sea to keep the channel clear ; but the obstructions in the entrance of Macquarie harbour consist of the finest sand, so easily scoured that the ebb current is able to maintain a channel 84ft. deep between Entrance Island and the mainland, and 40ft. to 50ft. deep at other parts higher up.

There is nothing new in the plans I have submitted to effect the deepening of Macquarie Bar ; it is the usual plan adopted all over the world for situations like this, the object sought being to contract the current so as to get depth in place of width, and in designing a work of this kind one has to be very careful so as to strike a proper mean between undue width and useless depth. In this case the width is fixed at 1,200ft. between the two breakwaters, which are to contract the existing width of about 7,600ft. Partly from experience, and partly from calculation, this width of 1,200ft. is reckoned to give a depth of about 25ft.; 1,200ft. by 25ft. is somewhat less than the existing waterway over the bar, but will really be a good deal more, because the velocity of water flowing through a channel is roughly as the square root of the depth.

While considering the depth one wishes to get at the entrance, it is of importance to avoid, if possible, throttling the tide in the lagoon, because the more tide-water that gets in and comes out again the more effective is the power to keep open a channel to the sea. I know a lagoon of about 9,000 acres which was provided with

breakwaters at its entrance into the sea to keep open a channel through its bar, but the breakwaters were placed too close together, and the consequence was that I was in a steamer going eight knots trying to get out to sea, and not being able to stem the flood tide rushing in, we had to turn back and wait till it slackened; the other result was that the range of tide in the lagoon diminished by about 18in., which was a very serious loss of tidal water calculated over 9,000 acres.

In this case it is certain that 1,200ft. wide, if it attains a depth of 25ft., will pass more water into and out of Macquarie Harbour than at present does so, but that is provided the channel through the shoals above Bonnet Island are deepened correspondingly; it is hoped that this may be effected by a long training-wall extending upwards for three miles from Mount Wellington as shown on the plan; but if this north channel refuses to scour out to a sufficient width and depth it must be touched up with a sand pump dredge.

The style of breakwater to be constructed is the old-fashioned embankment of rubble stone, heavy rocks being placed on the sides exposed to the waves.

If rock of suitable size is to be had, no one would dream of building any other kind of wall, because a rubble mound is far cheaper and safer than one of concrete. Of course, if stone of sufficient size cannot be got, other means must be taken, such as to build the mound up to half-tide level and cap it with loose concrete blocks, of weight sufficient to resist the waves; but I have seen no reason to suppose that there will be any difficulty in getting enough rock of suitable weight.

There is one inconvenience in building a rubble mound on loose sand, which is, that the waves and currents plough out the sand in front and at the sides of the mound, causing the stone to sink down into the holes thus made. This, of course, consumes a great quantity of stone, and no one can tell exactly how much extra stone will be thus required, the only thing one knows is that the influence of the waves can only extend a certain depth down, according to the height of the wave, and beyond that the sand will be undisturbed, and the stone will sink no further. In America, chiefly, they try to save stone by paving the bases of the mound with a thick mattress of brush fascines; this has succeeded in some places, and has failed and been abandoned in others; but in this country the cost of making and laying such mattresses is probably greater than that of the stone you seek to save by their use. In Westport, they tried to save the great quantity of stone which was consumed in this so-called "settlement" by pushing staging ahead, and paving the bottom with small rubble, but it was very uncertain whether any good was effected by this method, so that it would appear that the only thing to be done is to grin and bear this annoying settlement of stone in the sand, with the comfort of knowing that when your foundations have sunk to their limit the edifice will stand for ever, in spite of the warning given in the Bible about building on sand.

One might naturally be tempted to launch out into the most glowing anticipations of all that will come about when the breakwaters are completed, and Macquarie bar deepened to allow great navies to enter into this grand harbour, but it does not become me at this time to dilate on these triumphant fancies. The apotheosis of the engineer comes in when his work is finished, and until then he holds his peace and devotes his care and thought to seeing that the work is carried out diligently and properly, so as to ensure a successful completion. Let me, however, conclude this with the grand lines from Pope, which I hope the people and Government of Tasmania will take to heart:—

"Bid Harbours open, public Ways extend,
Bid Temples, worthier of the God, ascend;
Bid the broad Arch the dang'rous Flood contain,
The mole projected break the roaring Main;
Back to his bounds their subject Sea command,
And roll obedient Rivers through the Land:
These Honours, Peace to happy Britain brings,
These are Imperial Works, and worthy Kings."

The paper was illustrated by over 40 specially-prepared lantern slides, supplied by Mr. J. W. Beattie, hon. photographer to the Tasmanian Government, and explained by Mr. Back.

Hon. C. H. Grant, M.E.C., thought that the Society and the public were to be congratulated on having such a very able and interesting paper supplied for this meeting, and by an engineer who had the highest reputation for harbour works of any in the Australias. Mr. Napier Bell had been professionally consulted by the Governments of all these colonies, and his advice was entitled to the most favourable consideration. He had not been content with receiving reports from other engineers as to the peculiarities of the tides and their surroundings at Macquarie Harbour, but had resided at Macquarie Heads for several weeks and made the most careful personal investigation into all the conditions before perfecting his plans. We are, therefore justified in having full confidence as to the result of their being carried out, and it is to be hoped that not alone the partial works at present provided for, but the whole scheme will be completed. The resources of the Western District justified the proposed expenditure. He (Mr. Grant) had seen similar works, but on a much more extensive scale, made universally successful in various

parts of the world. The use of broken stone filling in place of cement blocks would enable the work to be completed in less time, and was attended with less risks. The peculiarities of the tides at the entrance to Macquarie Harbour, described in such a clear and interesting manner in the paper, were in some respects new to him, and different to what obtained in similar harbours. This was doubtless due to the extensive inside area, compared with the size of the entrance, and the large quantity of fresh water always flowing into the harbour owing to the abnormally large rainfall of the West Coast.

Hon. N. J. Brown, M.E.C. (Speaker of the House of Assembly), emphasised the obligation of the Society and the public to Mr. Bell for his paper. There were many points of scientific interest touched upon, but its practical character was of great importance, because it was calculated to increase confidence in the scheme. He could never understand the objections raised to making Macquarie Harbour accessible to steamers of deeper draught than those now engaged in the trade of the port, and sailing ships. If it was a mistake to do this, then the spending of so much money as has been spent in dredging the Tamar and the Mersey, and in improving the harbour of Burnie was a mistake. (Hear, hear.) The more easily communication by sea was made to this colony, by so much would the cost of production be decreased, and that decrease meant so much addition to the wealth of the whole colony. (Applause.) Our territory was small, and here, more than in the larger colonies, it was obvious that no portion of this island could be largely benefited without that benefit spreading over the whole of the community. He looked with confidence to the completion of this important work under the direction of such a skilled engineer as Mr. Napier Bell. (Applause.)

Captain Miles, M.H.A., warmly commended Mr. Bell and his paper. He claimed that the deepening of the bar would be of enormous benefit to the colony, because it would cheapen the carriage of fuel for treating low-grade ores, and so develop the West Coast mineral fields. (Applause.)

Mr. R. M. Johnston gave a geological description of the rocks occupying the basin of the Macquarie Harbour. He stated that in early tertiary times this great basin formed a fresh water lake, whose wasted sediments still remain forming a fringe on the northern side from Strahan to Kelly's Basin, composed of clays, sands, lignites, and beds of coarse shingles. The old lake, like that of the Derwent, was subsequently encroached upon by the advancing waters of the sea, whose action in again wasting the softer sediments of the old lake was accelerated by a long-continued slow subsidence of the land. This action continued until the present inland sea basin was formed. Mr. Johnston also drew attention to the erratic tidal rise and fall, and said it bore some correspondence to peculiar tidal waves observed for many years by Mr. Russell, Government Astronomer of New South Wales, in the harbours of Sydney, Newcastle, and elsewhere, the causes of which, for the most part, he ascribes to distant storms acting in conjunction with a particular direction of the wind.

After the exhibition of the views the meeting terminated with the usual votes of thanks.