JUNE 11th, 1907.

The monthly meeting of the Royal Society was held at the Tasmanian Museum on Tuesday night. His Excellency the Governor, Sir Gerald Strickland, presided.

The acting-secretary (Mr. R. M. Johnston) reported that he had accepted the appointment as delegate to represent the society at the centenary of the London Geological Society.

His Excellency remarked that the society was fortunate in having such an authority on geology as Mr. Johnston to represent it in London. They were in debted to Mr. Johnston for having undertaken to represent the society.

Mr. Johnston informed the meeting that the society had received an invitation to send a representative to Boston to take part in the Zoological Congress in August. He added that he would be able so to arrange his itinerary as to be present in Boston in August. Further, he suggested that Mr. McNaghten, who was formerly in Tasmania, and now at Montreal, might also be asked to represent the society.

On the motion of Mr. A. O. Green, Mr. Johnston and Mr. McNaghten were appointed delegates to the Boston Congress.

NOTE ON THE BEN LOMOND PLATEAU, AND THE DISCOVERY OF HIGH LAND AT THE NORTH END.*

Mr. E. L. Piesse, B.Sc., read the following paper by Colonel W. V. Legge, late R.A., F.R.G.S., on the Ben Lomond Plateau, and the discovery of the high land at the north end.

It seems desirable that the "Royal Society Journal" should contain some preliminary notes on my forthcoming treatise on the physiography of Ben Lomond for the meeting at Adelaide of the A.A.A. Science, the principal object of this paper being to give an account of the discovery of higher land than the bluff or fell on which the ordnance survey trigonometrical station is situated. It is with this view, therefore, that I have the pleasure of submitting the following short account of the work done in March, 1906 by a small expedition which I formed for the examination of the plateau at the north end. Little or nothing has been known scientifically of this part of Ben Lomond. It is never visited by tourists being too remote from the trig. station, which is approached from the Avoca direction only. Hunters are said to occasionally ascend from the valley of the North Esk, and very rarely from the Mathinna country; but, on the whole, this area is as untrodden as the distant ranges of the West Coast.

The Ben Lomond Fell is a remarkable prominence in the escarpment of the southern end of the plateau, standing 200ft. above the surrounding crags, and has all the appearance, both from the low country and the adjacent "trough" valley and moor belts, lying to the north of it on the plateau, of being the highest part of the range. Hence, presumably, the reason that it was originally chosen as the position for a "pile" to connect the mountain with the triangulation to the west of it.

Looking north from the summit of this fell, the great moorland, which for the first five miles consists of generally level belts, seamed by long valleys, is seen to be divided by a deep transverse valley running from east to west, from a lofty upland, which rises near its centre to a north and south crest-line. A conspicuous hollow, passing to the north through this elevated track, gives additional prominence to it. The southern slopes of the hill, moreover, descend abruptly into the cross valley, and give this central group a generally elevated appearance. So marked is this that tourists viewing it from the trigonometrical station have often expressed the opinion that it was higher than the ground on which they stood. The strongest support, however, of this hypothesis has for many years been afforded to the writer by a study of the climatology of the pleateau and particularly the high north end in question from his home, near St. Mary's from which point of view the whole range is clearly seen.

The frequent cloud-capping of this tract prior to the advent of strong, and often damp, north-westerly winds, the southern end being, at the same time, free from all mist; earlier covering at the commencement of generally cloudy conditions throughout the district; heavy snowfalls in this part when the south of the plateau is almost free from a white mantle; and, finally, a much longer duration of snow during the general spring melting—have all tended for years to convince the writer that the north end is the higher area of the great mountain.

Hence the formation of a project after the conclusion of the congress of

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[* Submitted for reading at the meeting in November last, when Professor Baldwin Spencer gave his lecture, but withdrawn by the writer, as no local matter was considered at that function. The paper is now re-submitted, as the treatise on the Ben Lomond Plateau, read at Adelaide, is not yet published.]

the A.A.A. of Science at Dunedin to carry out an exploration of the entire plateau, investigate the physiography of the moorland, and make a compass, or plane-table, topographical survey of its area. The easiest approach to the summit from the eastern districts being by way of Mangana, it was decided to carry out the work from that side. A thermometrical station for finding maximum and minimum temperatures was established on the moorland, at the rear of the south-eastern corner of the escarpment during the month of September, 1905, and in January, 1906, a base for triangulation of the southern area was laid out with the help of Mr. D. Macleod, of Mangana, on a flat part of the moor contiguous to the station. A survey of a portion of the south-eastern area followed, accompanied by an examination of the interesting flora of this alpine region, in which the hardy *Richea*, *Orite Olearia* and other alpine shrubs play a conspicuous part. An examination of the lake system with the watershed drained by the tarns, or lakes, was made, which demonstrated the incorrect position of the same as shown on the existing maps, in which only one is marked lying near the centre of the moorland. In point of fact, there are three sheets of water in the Nile valley, the so-called Youl's lakes, and another tarn, larger in area than any of the above, situated close to the eastern face of the plateau, and possessing no properly recognised name. This lake is fed by small runnels from the hills or tors which flank it; and at its head by similar sources rising in springs about 800 yards from the shore. About the same distance from these springs, in the opposite direction, the divide, which is quite level in the interval, sends its drainage by a small brooklet down a sloping vale, and through a gorge in the escarpment to the foothills above Mangana. This creek, therefore, is the most alpine source of the so-called "Tower Hill" rivulet, which drains the valley of Mangana into the South Esk.

It may be mentioned here that the summits of the lofty crags, forming the south-eastern mural boundary of the Ben Lomond range do not attain anywhere a greater altitude than 4,500ft., although they have the appearance, from the low country in the eastern districts, of being almost as high as the fell on which the trigonometrical station is situated.

To continue the work, and explore the northern area of the moorland, a small expedition was formed by the writer in March, 1906, to ascend the mountain by the new track made by the Fingal Road Trust from Mangana, and towards which the Premier kindly had a sum of £50 added to what was collected in the district. I was fortunate enough to enlist the services of Mr. Lyndhurst Giblin, well known as an explorer and mountaineer the Government Analyst (Mr. Ward) and his brother completing the party. We left Mangana early on the morning of March 29, and took the new track, which is an excellent one, after once mounting the spur, leading up from Trotter's Valley, all the way to the foot of the talus slopes, which descend from the escarpment on all sides of the plateau. Thence for 900ft., or more, up through the gap in the cliffs to the edge of the moorland, it is very steep, but when slightly improved will make the ascent of no difficulty. Our camping ground was selected under the shelter of some erect diabase columns not far from the creek above-mentioned, which was named the Mackenzie Rivulet. By noon on the following day all baggage and stores had been "swagged" up the steep track from our temporary depot below. The clearing-off and uprooting of the intensely rigid-branched alpine shrubs, *Orites*, *Olearia*, and *Leptospernum* (mountain ti-tree), is no mean undertaking without good axes, and thus the formation of a camp site was a little difficult. The elevation of it was 4,300ft., but the nights were so mild that we slept comfortably with an open tent-front.

The first two days were spent in further exploration of the southern division of the moorland, tracing the watercourses, and surveying the upper lake and its surroundings. The third day (Saturday) was fixed for the trip to the north, but we were fog-bound during the whole of it, and we deferred the undertaking till the Monday following, deeming it advisable to carefully set our aneroids at the trig. station, with the camp as a station-base, before visiting the high land beyond the dividing valley. We were favoured with a steady "glass" on the Sunday, and in the afternoon made a trip to the trig. station. The official height, 5,010ft., was found to be 112ft. above that given by the barometer, this being probably due to "lag" of the aneroid during the four days, and to the smaller division of the feet scale at the height from which we started 4,300ft. On the return to camp, at 6 p.m., the "reading" was as at noon. We had a steady barometer on the following morning, and took careful readings before starting. Thus, the difference in altitude between the camp and any heights ascended that day would be proportionate to those observed on our trip to the station on the previous day.

Our track lay over the high eastern moor belt, and across two of the characteristic "trough" valleys, which are minutely described in my treatise on the mountain. On the floor of these we discovered three picturesque, but shallow, tarns discharging southward, as was sub-

sequently ascertained, into the Nile system. It is noteworthy that all the tarns, or pools, on the plateau are shallow, owing to the floor of the valleys consisting of diabase boulders, lying immediately beneath the vegetation, their interstices and irregularities being filled with plant-humus and the rock-weathering of countless ages, on which the alpine vegetation thrives; consequently, the depressions which happen to hold the drainage from springs around them must of necessity be shallow.

On crossing the head of the dividing valley near its eastern outlet the country rose gradually to the group of hills in the centre of the moorland, noticed above, and which the writer named the "Giblin Fells." We passed up a talus-floored valley till a low water-parting was reached at the back of the great precipices overlooking the Tyne valley, and which was named "Ossian's Throne." Here is situated another tarn, fed by springs from the Giblin Fells, which has scarcely any outlet, but the drainage from which, in wet weather and at the time of the snow melting, naturally forms a burn running to the north. This receives streamlets on its left bank from the high fells, and develops into a creek issuing through a deep gorge towards the Rose's Tier divide, and flowing either into the Ford River or the Tyne, becoming, therefore, the true alpine source of either the North or the South Esk.

In this vale, which is well clothed with poa and other grasses, a halt was made for lunch, and the spot named "Meadow vale." The height of Ossian's Throne was found by aneroid to be approximately 4,900ft., the successive eminences of the escarpment all round to the north being, apparently, on a level with it, and consequently all higher than the southern bluffs of the mural boundary.

In the afternoon an ascent of the hills was made by Mr. Giblin and the writer, the former proceeding to what appeared the highest ridge, and the latter taking a lower crestline for investigation. At a point further north than our resting-place two depressions pass into this central group of hills from Meadow valley to the west, and divide the high land into two ridges, the northernmost of which is the higher. Down these hollows the little tributaries of the aforementioned creek descend, rising in springs, which are, perhaps, the highest in all Tasmania. Much grass, and an absence of the thick clothing of alpine bushes met with over the southern area, are noticeable in ascending these vales. At the foot of the higher ridge ascended by Mr. Giblin, the diabase formation crops out in columnar masses facing Meadow Vale, at the foot of which, as is seen all over the plateau, are small fields of talus descending to the main valley.

The summit of the ridge, which is reached in about three-quarters of a mile from its foot, is composed of rocky knolls or tors, flanked by slopes of talus, below which, as Mr. Giblin reported, the sides of the hill were grassy. The ridge ascended by myself was very rugged, broken on its crest into small, though precipitous, tors, with intervening areas of very rough talus. The ascent of this ridge took, approximately, the same time as occupied by Mr. Giblin in surmounting the ridge to the north, which was made by aneroid reading to be about 50ft. higher. On his return from his climb he reported his reading to be 160ft. plus or minus 40ft. higher than that given by the ascent of the trig. station the previous day.

As a good view of the northern end of the plateau was obtained from Mr. Giblin's position, he found that the escarpment there was as high, if not higher, than the point, Ossian's Throne, mentioned above, and that the north-western corner consisted of a tableland holding some pools, or tarns, within its area. The stream passing down Meadow Vale was found, as already stated, to issue through a deep gorge to the north. The high group of fells (the name given, as above quoted, to this highland was in memory of Mr. Giblin's father, the judge, and in honour to himself as making the chief ascent of the day) occupies the major part of the northern area, which is, on the whole, different from the southern one in topographical features. The general conformation, conforming to a higher level, and the valley running north and flanking the group on the west, precludes the existence of the shallow trough valleys characteristic of the southern division of the moorland. Further explorations will probably discover interesting features* in the physiography of this little known tract of the great plateau.

Mr. Piesse also read a paper by Mr. L. F. Giblin, B.A., and himself on "The Height of Mount Legge (the name suggested for the tor forming the summit of the Giblin Fells at the northern end of Ben Lomond), with remarks on the Trigonometrical Survey of Tasmania."

Discussion.

Mr. A. O. Green, Mr. Johnston, and Dr. Noetling offered a few observations on the foregoing papers.

On the motion of Mr. Green, seconded by Mr. B. Shaw, it was decided to ask the Minister of Lands to adopt the name of Mount Legge for the northern peak of Ben Lomond.

Opsonic Index.

Mr. Johnston read a paper by Dr. E. J. Roberts on "The Germ as a Friend in Therapeutics" (Opsonic Index.) The paper dealt largely with the investigations which have been made for the purpose of determining what might be called the strength of an antitoxin for combating an infectious disease as it occurs in a particular patient.

Dr. Elkington, the Chief Health Officer favoured the society with some remarks on Dr. Roberts's paper.

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* Mr. Giblin was good enough to name the tor crowning the high ridge of the fells he ascended Mount Legge, in honour of my leadership of the expedition to find the altitude of the northern area of the plateau

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THE BEN LOMOND RANGE.

NOTE ON THE HEIGHT OF LEGGE TOR.

(By Messrs. L. F. Giblin, B.A., and E. L. Piesse, B.Sc., read June 11, 1907.)

During two visits to the Ben Lomond Range in March, 1906, and March, 1907, we made some observations of the height of the northern part of the range, which we wish to bring to the notice of the society. On both occasions our parties were under the guidance of Colonel Legge, who has frequently visited the range, and who has given a full description of it in a paper read at the last meeting of the Australasian Association for the Advancement of Science. It was at his suggestion that we made the observations we now describe.

The most conspicuous feature of the Ben Lomond Range is the south-western summit, surrounded on two sides by high diabase cliffs, which is seen from the main line railway for many miles. On this summit is situated one of the stations of the Trigonometrical Survey of Tasmania made in 1851 and the following years. The maps of Tasmania based upon this survey show tht height of this station to be 5,010ft., and it has usually been thought to be the highest point of the range, and the highest point in Tasmania, with the sole exception of Cradle Mountain, which is stated on the maps to be 5,069ft. high. It should, however, be mentioned in discussing the heights of our highest mountains that no exact observations seem to have been made for the height of Barn Bluff, which is over 5,000ft.

Looking northwards from the Trigonometrical Station, the range is seen to extend for seven or eight miles, with a width of three or four miles. A wide and deep valley, called by Colonel Legge the Dividing Valley, separates the summit into two areas of noticeably different character. The southern portion may be roughly described as a plateau, intersected by shallow and wide valleys, lying from 500 to 1,000 feet below the summit before mentioned, which rises out of the plateau at its south-western corner. The northern portion is much more broken in appearance, and its average height is much greater than that of the southern half of the mountain. In the centre of the northern half, about one and a half miles distant from the northern, eastern, and western escarpments of the range lies the summit which is the subject of this note. From the trigonometrical station this summit appears to the unaided eye to be the highest point of the mountain. Our observations were made to determine the difference of height between the trigonometrical station and the northern summit. For this purpose we used in the first instance an aneroid barometer, and subsequently we obtained a rough check from observations with an Abney level. We are aware of the many sources of error incident to the use of aneroids, but the instrument used was a good one, and most of the observations were made in good conditions, and we therefore think the results are worth publishing.

The comparison of heights was made in three stages. In the first place we found the height of Colonel Legge's camp at Broken Bluff, at the south-eastern corner of the mountain, near Col. Legge's thermometrical station, and a short distance from the end of the track from Mangana. Taking the mean of ascending and descending readings (which is the method recommended by Mr. Edward Whymper in his paper, "How to use the Aneroid Barometer"), and correcting for a fairly uniform change of pressure which was taking place during the day, we found that Broken Bluff camp was 710 feet below the trigonometrical station. In 1906 the instrument used this year, and another instrument, each gave 720 feet for this stage. The height of Broken Bluff camp is therefore about 4,300 feet—a result probably correct within 20ft. or 30ft. unless some hidden source of error was present on each occasion.

The next stage was from Broken Bluff camp to a second camp at Meadow Vale, a grassy valley in the northern portion of the range, four or five miles from Broken Bluff. From our observations on March 16, we found that Meadow Vale was 400ft. above Broken Bluff. We made

the return journey on March 18, observing the barometer at short intervals for an hour to two before leaving Meadow Vale, and after reaching Broken Bluff. From these observations we computed the difference of height to be from 420ft. to 470ft., the uncertainty arising from our imperfect knowledge of the variations of pressure due to atmospheric changes during the day. Combining all the observations on both days, we took Meadow Vale to be 430ft. above Broken Bluff. The height of Meadow Vale is therefore about 4,730ft., but this result, for the reason stated, is more uncertain than that for the first stage.

The third and final stage was from Meadow Vale to the highest point of the northern part of the mountain. The mean of closely agreeing ascending and descending readings gave a difference of height of 440ft. The northern summit therefore appears to be about 870ft. above Broken Bluff. In 1906, with another instrument, the mean of ascending and descending readings taken on the same day between Broken Bluff and the northern summit was 860ft. Adding this number to the height of Broken Bluff, 4,300ft., we find that the height of the northern summit is in round figures about 5,150ft. If this result be correct, the northern summit is therefore about 150ft. higher than the trigonometrical station at the south-western corner of the mountain, and about 70ft. higher than Cradle Mountain, and therefore appears to be the highest known point in Tasmania.

This result cannot, however, be accepted as final. In spite of the close agreement between the observations made in 1906 and those of 1907, we cannot be quite certain that there are no hidden sources of error which might vitiate the result. Such errors are of two classes—the first, those due to the necessary imperfections of the aneroid as a means of measuring pressure, the second those due to diurnal and irregular atmospheric changes of pressure taking place whilst we were going from one point of observation to another. Of the first class the phenomenon of elastic fatigue, also known as "lag" or "hysteresis" is the most usual source of error. For such small differences of altitude as we were measuring, this is not very great, and we took sufficient readings to eliminate it. There are, however, other sources of uncertainty, such as change of index error, against which we could take no precaution. Of the second class of errors the uncertainty due to irregular atmospheric changes may affect the second stage of our work, but not, we think, the first and third stages. As to the regular diurnal changes we have no information which will enable us to supply a satisfactory correction.

As a check upon the determination by aneroid, we took an altitude observation with an Abney level. From the northern summit the trigonometrical station had a depression of about three-quarters of a degree. The distance apart of the two points is from six to seven miles. After allowing for a possible observational error of from 20 minutes to half a degree, we find that the northern summit is at the least from 100ft. to 200ft. above the trigonometrical station, so that its height appears from the Abney level observation to lie between 5,100ft. and 5,200ft.

We hope to be able next summer to make a small triangulation on top of the range, and so determine within a foot or two the difference of height of the two summits. We think it well, however, to place on record at once the results of our preliminary work.

The question may be raised: If, as our observations suggest, the northern summit is the highest point on the range, and probably the highest point in Tasmnaia, why is not this fact recorded on the maps compiled from the trigonometrical survey of the island? Such records as there are of the work of this survey are not in a condition to be readily intelligible to a casual inquirer, but we understand that they do not contain any observations of the northern summit. Several reasons, however, suggest themselves why it was unlikely that any observations of it should be made, even if, as was doubtless the case, its great height was noticed. The station on Ben Lomond formed part of the principal network of triangles which connected the base at Ralph's Bay with the base of verification at Longford, and which was the basis of the secondary triangulation from which the maps of Tasmania are compiled. When the principal triangulation had been extended northwards as far as Miller's Bluff (on the Great Western Mountains), and Mount Connection (on the Eastern Tiers midway between Ross and Swansea), it was necessary to choose a third point to the north, which with these two points would form a well-conditioned triangle. It so happens that the present trigonometrical station forms a triangle which is very nearly equilateral, and, is, therefore, well suited to be a part of the principal triangulation. If the northern summit of the Ben Lomond range had been chosen, the triangle formed by it with the two mountains mentioned would not have had quite such a good shape, and it would probably have been found that Mount Connection was invisible from it. Further, in choosing the principal stations of the survey, regard was doubtless had to their subsequent usefulness in land surveying. The present trigonometrical station was clearly the better for this purpose, for it is a conspicuous object from the valleys of the South Esk, the Macquarie, the Lake, and the Meander Rivers, all of which valleys were then

settled. The northern summit, on the other hand, even where it can be seen, is not a good object from these valleys, and would have been useful only for surveys of the country to the north and north-east, which was then an almost untrodden wilderness. The absence, therefore, of any mention of this northern summit from the records of the trigonometrical survey is no evidence against its being the highest point of the range.

In making a more careful determination of the height of this northern summit in the way we propose, some examination is required of the meaning and accuracy of the statement on the map that the height of the trigonometrical station on Ben Lomond is 5,010ft. Postponing for a moment the doubt as to the precise point in space to which this statement relates, it may be said that there is little doubt that it represents the results of observations and calculations of very high accuracy. The general accuracy of the trigonometrical survey of Tasmania may be gauged from the fact (recorded in Major Cotton's paper on the survey, read before this society in 1854), (1) that when the base of verification, about five miles in length, near Longford, was measured, it was found that the difference between the measured length and that computed through thirteen triangles from the original base at Ralph's Bay, was only 3½in. —a result which so much astonished Sir William Denison, then Governor of Tasmania, that he checked the whole of the computations for himself, and found them quite accurate. It is true that the accuracy of this survey was impugned by a later Surveyor-General, and the maps drawn from it have been the subject of much criticism, but it seems safe to adopt the view of Mr. T. F. Furber, Director of the trigonometrical survey of New South Wales, contained in his paper on trigonometrical surveys, read before the Australasian Association for the advancement of Science in 1898 (2), that the observations and calculations were made with accuracy. The same cannot be said of the maps of Tasmania, for the rude sketches issued by the Department of Lands and Surveys are a disgrace to the colony. No blame can attach to this department for its inability to map those parts of the country, which are still unsurveyed and practically unexplored, but it is surely an example of our proverbial sleepiness that for so many years no improvements have been made in the mapping of districts which have been settled for nearly a century. In the representations of the mountain systems the maps are particularly defective. The system of hatching used to represent heights is not a good one, mountain ranges are frequently shown as rows of isolated and unconnected peaks, rising out of plains, and no attempt is made to depict plateaus and highlands. In the preparation of the latest map of Tasmania, published about 25 years ago, the use of contour lines was proposed, but this intention was abandoned, and the method of representing mountains actually used is inadequate and misleading. The ignorance of the topography of the island which is so common among us, is a direct result of the defects of the maps. The new map showing in colours the height of the different portions of Tasmania which the Director of Education is now having prepared for use in the State schools, may at last enable us to get a clear view of the vertical relief of Tasmania, which, as one of the determining causes of the distribution of human activities and of other phenomena, is a central feature of the geography of this as of other countries.

Returning to the trigonometrical survey, it appears that the system of marking the stations was not an accurate one, although the observations fixed the positions of the stations to a few inches. Usually an irregular cairn of stones was erected, presumably over the spot where the instrument was set up, and in this a wooden pole was inserted. It is usual in surveys of this kind to mark the exact position over which the instrument is set up by a metal plug set up in the solid rock, but this does not seem to have been done in Tasmania. (3) On Ben Lomond, a four-sided yard (locally known as the "Stockade") was built of logs carried up by prison labour from the forests below, and inside this there are remains of a small stone cairn. But in the lapse of 50 years, both yard and cairn have almost disappeared, and the horizontal and vertical position of the point of observation are now uncertain to some feet.

Whether or not the northern summit of Ben Lomond be the highest point in Tasmania, or the highest point of the range, it should have a name. The name Ben Lomond is commonly applied to the whole range, but is particularly associated with the south-western summit on which is the trigonometrical station. Between this and the northern summit there lies, as has already been stated, a deep valley, and it is, therefore, in accordance with the usual practice in such matters that the summits should be distinguished by separate names. For the northern summit we now invite the Royal Society of Tasmania, one of the leading objects of which is stated in its Constitution to be the investigation of "the Physical

Character of the Island," to adopt the name of Mount Legge (4), in honour of Colonel W. V. Legge, R.A., of Cullenswood House, Cullenswood, one of the vice-presidents of the society, and the president of the Council of Agriculture, who by his papers read before this society and before the Australasian Association for the Advancement of Science, has largely increased our knowledge of the physical features of the mountain systems of Tasmania, and particularly of Ben Lomond.

(1) Cotton: The Trigonometrical Survey of Van Diemen's Land (Proc. Roy. Soc. Tas., vol. 3, p. 82).

(2) Report A.A.A.S., vol. vii., 1898, p. 176.

(3) See Report of the Select Committee on the Trignometrical Survey, 1857 (Journals of the Legislative Council, Vol. II., 1857, Paper No. 32).

(4) Note added July, 1907—The name "Legge Tor" has been adopted by the Department of Lands and Surveys for the northern summit.